THE PLESSEY COMPANY LIMITED
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SERVICE MANUAL

FOR

HF RADIO RT320

Volume 2

Third line servicing

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SERVICE MANUAL

FOR

HF RADIO TYPE RT320

HEALTH HAZARDS

THE RF POWER TRANSISTORS USED IN UNIT 2a OF THE RECEIVER/TRANSMITTER CONTAIN BERYLLIUM OXIDE MATERIAL WHICH, IF NOT PROPERLY HANDLED, CAN CONSTITUTE A SERIOUS HAZARD TO HEALTH.

UNDER NO CIRCUMSTANCES SHOULD THESE TRANSISTORS BE DELIBERATELY EXPOSED TO FIRE, BROKEN OPEN OR ABRADED.

SCRAP TRANSISTORS MUST BE PLACED IN A CONTAINER WHICH IS CLEARLY LABELLED "DANGER BERYLLIUM OXIDE MATERIAL IN THIS CONTAINER". SUBSEQUENT ACTION MUST BE IN ACCORDANCE WITH THE APPROPRIATE NATIONAL REGULATIONS FOR DISPOSAL OF HAZARDOUS TOXIC MATERIALS.

WARNING:

1. WHEN BERYLLIUM OXIDE IS EXPOSED TO FIRE IT RELEASES LARGE QUANTITIES OF TOXIC FUMES.

2. DUST FROM BERYLLIUM OXIDE PRESENTS A SERIOUS TOXIC HAZARD.

SERVICE MANUAL

FOR

HF RADIO TYPE RT320

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1	First line servicing
2	Second line servicing
3	Third line servicing
4	Testing at third line

NOTE: Parts 1 and 2 of this manual are located in Volume 1, part 3 is located in Volume 2, and part 4 is located in Volume 3.

SERVICE MANUAL

FOR

HF RADIO TYPE RT320

PART 3

THIRD LINE SERVICING

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4	Reflectometer (Unit 2b)	419/HA/11830
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9	Tuner RF (Unit 4)	640/HA/09592
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THIRD LINE SERVICING

OF

RECEIVER-TRANSMITTER RT320

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GENERAL

1. Part 3 gives information additional to that given in Parts 1 and 2 such that Parts 1, 2 and 3 together with the test procedures in Part 4 provide all the information required by a third line servicing technician.

2. In particular, this part of the manual is sub-divided into a number of sections thus:

(1) Section 1 (this section) gives general and specific information common to all sections, together with some reference information.

(2) All other sections each detail one module which can be independently tested at third line and which may well be sent to third line for repair as a separate item. Each section contains relevant circuit description, and other support information.

REPAIR POLICY

General

3. Repair at third line will consist of the re-instatement of faulty equipment, assembly or module by replacement of faulty component parts.

4. Any item which cannot be repaired at third line should, according to local instructions, either be scrapped or returned to the manufacturer for repair. Items returned to the manufacturer should be packed in the container in which the replacement was received.

5. The provision (in Part 4) of test procedures for each module should not be taken to imply that a complete receiver/transmitter, unit 1 or unit 2 returned to third line for repair should automatically be disassembled to its sub-assemblies without subjecting the complete item to any tests.

6. The majority of sub-assemblies are interconnected by soldered wire leads, the soldering/unsoldering of leads should be kept to a minimum to avoid the introduction of faults and deterioration of equipment. It is preferred that individual components be replaced in-situ, and that access to the components be gained by partial disassembly, i.e. by removal of covers, screens etc and, where necessary, removal of securing screws and moving the assembly or sub-assembly within the limits imposed by the wire leads.

7. Hence, a sub-assembly should only be removed when all of the following conditions are met:

(1) It is definitely established as faulty.

(2) It is not possible to gain access to the faulty component without further disassembly or it is not possible to determine the faulty component under the present test conditions, or both.

8. A module should be removed if a repair to the module necessitates re-adjustment of preset controls within that module and the adjustment is only possible when the module is tested as a separate item.

CAUTION: 1. DC VOLTAGES IN EXCESS OF 3V MUST NOT BE APPLIED TO ANY CIRCUIT UNLESS OTHERWISE STIPULATED.

2. BUZZER CIRCUITS MUST NOT BE USED FOR CONTINUITY OR ANY OTHER TEST UNDER ANY CIRCUMSTANCES.

Soldering

9. Excess heat can damage insulation, components etc. For all soldering and unsoldering operations, use a heat controlled iron set at 325°C $\pm$ 25°C and apply the heat for no more than 5 seconds. A tool which removes excess solder must be employed.

10. For all soldering use solder, resin cored, 60/40 tin lead Type 1 to British Standard BS441.

Repair of Panels, Electronic Circuit

11. When fitting a component to a panel, electronic circuit the following procedure should be observed:

(1) Prior to soldering, clean the areas to be soldered, using the mini-

mum amount of cleaning fluid (see para.12), and a soft brush. Allow the area to dry before proceeding.

(2) If an insulating pad was used to separate the body of the original component from the panel, check that this pad is still serviceable, if necessary use a new pad.

(3) Position the component, including insulating pad if required, in its appropriate location on the panel. Refer to figure 1 for typical mounting details.

(4) Solder the connections between the component and the panel taking care that neither too little or too much solder is used. In particular, ensure that the solder does not reduce, or close, the gap to an adjacent track.

(5) Crop excess wire as indicated in fig.1.

(6) Remove flux residue by the cleaning procedure given in sub-para.(1).

12. The recommended cleaning fluid is trichlorotrifluoroethane. Common prorrietary names are Freon, Isceon 113 and Arklone P.

TESTING AFTER REPAIR

Modules

13. Any module to be returned to the second line facility as a serviceable spare or to be fitted to its parent assembly at third line must satisfy all the tests given for that module in the relevant section of Part 4 of the manual.

Unit 1, Unit 2

14. Whether Unit 1 has been repaired or not, it must be tested in accordance with the front panel test procedures given in Part 4 of this manual. All these tests must be satisfied before the unit can be returned to the second line facility as a serviceable spare or before the unit is assembled to a complete receiver/transmitter at third line.

15. Similarly, unit 2 must satisfy all the rear panel tests given in Part 4 of this manual.

Receiver/Transmitter

16. Before a complete receiver/transmitter unit can be returned to second line as a serviceable spare, it must be closed, sealed and then satisfy all the tests given in Part 4 of this manual.

ADDITIONAL INFORMATION

Circuit Diagrams

17. For cross reference purposes, separate circuit diagrams for Units 1, 2 and 6 are given in Figs.2, 3 and 4. The information contained on these diagrams is integrated into the functional block/interconnection diagrams in Part 2 of this manual.

Unit 6

18. Units 6a, 6b, 6c/d and 6e, although located on Unit 6, are separate sub-assemblies of Unit 1 and are detailed in relevant sections of this part of the manual. Unit 6 is a sub-assembly of Unit 1, it cannot be separately tested but does incorporate discrete components as indicated on Figs.4 and 5. Details of these components are given in a components list in this section.

19. The principal component parts of Unit 6, 419/1/30243 are listed below and the component layout is given on Fig.5.

Cct.Ref.	Description	Reference No.
Resistors		
R1,2	10k ohm ± 2% 0.25W	403/4/05524/100
R3,5	3.9k ohm ± 2% 0.25W	403/4/05523/390
R4	5k ohm ± 10% variable 0.5W	404/9/05032/005
R6	150 ohm ± 2% 0.25W	403/4/05522/150
R7	180 ohm ± 2% 0.25W	403/4/05522/180
R8	2.2k ohm ± 5% 0.25W	403/4/05553/220
R9	100 ohm ± 2% 0.25W	403/4/05522/100
R10,15,16	1k ohm ± 2% 0.25W	403/4/05523/100
R11	510k ohm ± 2% 0.5W	403/4/05325/510
R13	5.6k ohm ± 2% 0.25W	403/4/05523/560
R14	4.7k ohm ± 2% 0.25W	403/4/05523/470
Capacitors		
C1,4	180 uF ± 10% 6V electrolytic	402/4/55723/180
C2,3,5	68 nF ± 20% 50V	400/4/20544/680
Inductors		
L1	Inductor 18 uH ± 10%	406/8/08470/027
Semi-conductor devices		
D1,2,3,5,6	Diode, C756	415/4/98869
D4	Not used	
ML1	Integrated circuit CN497T	446/4/00429
Miscellaneous		
RLA	Relay	507/9/05095

NOTE: Units 6a to 6e inclusive are separate sub-assemblies of Unit 6.

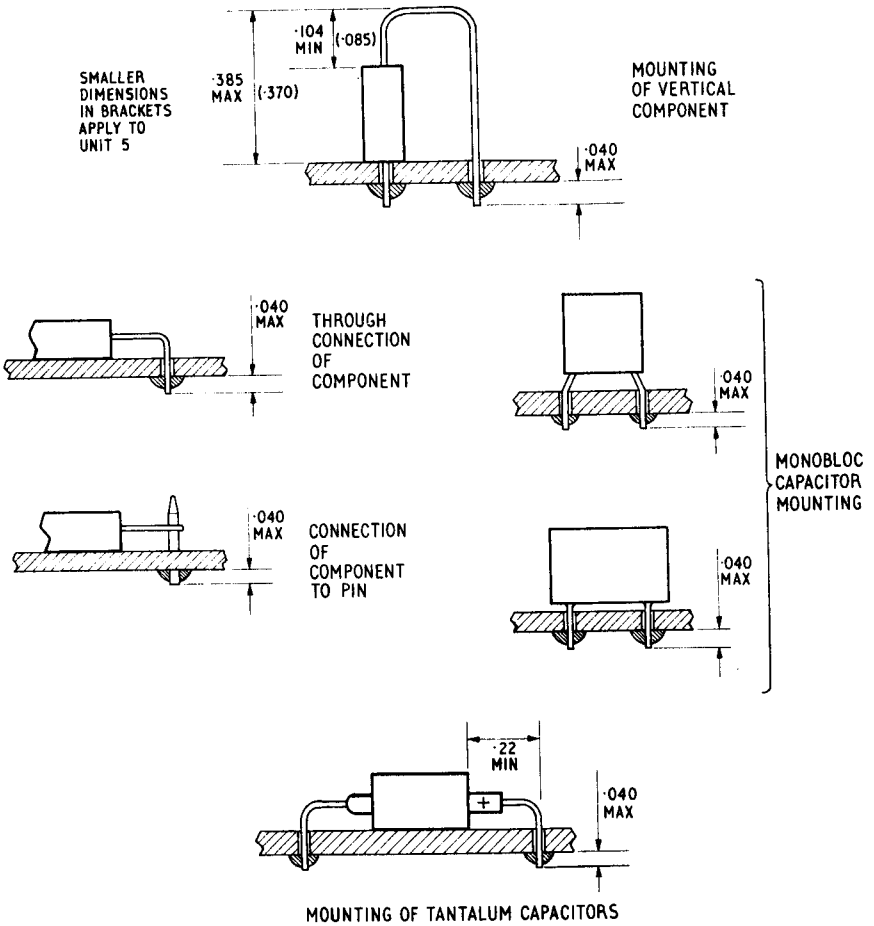
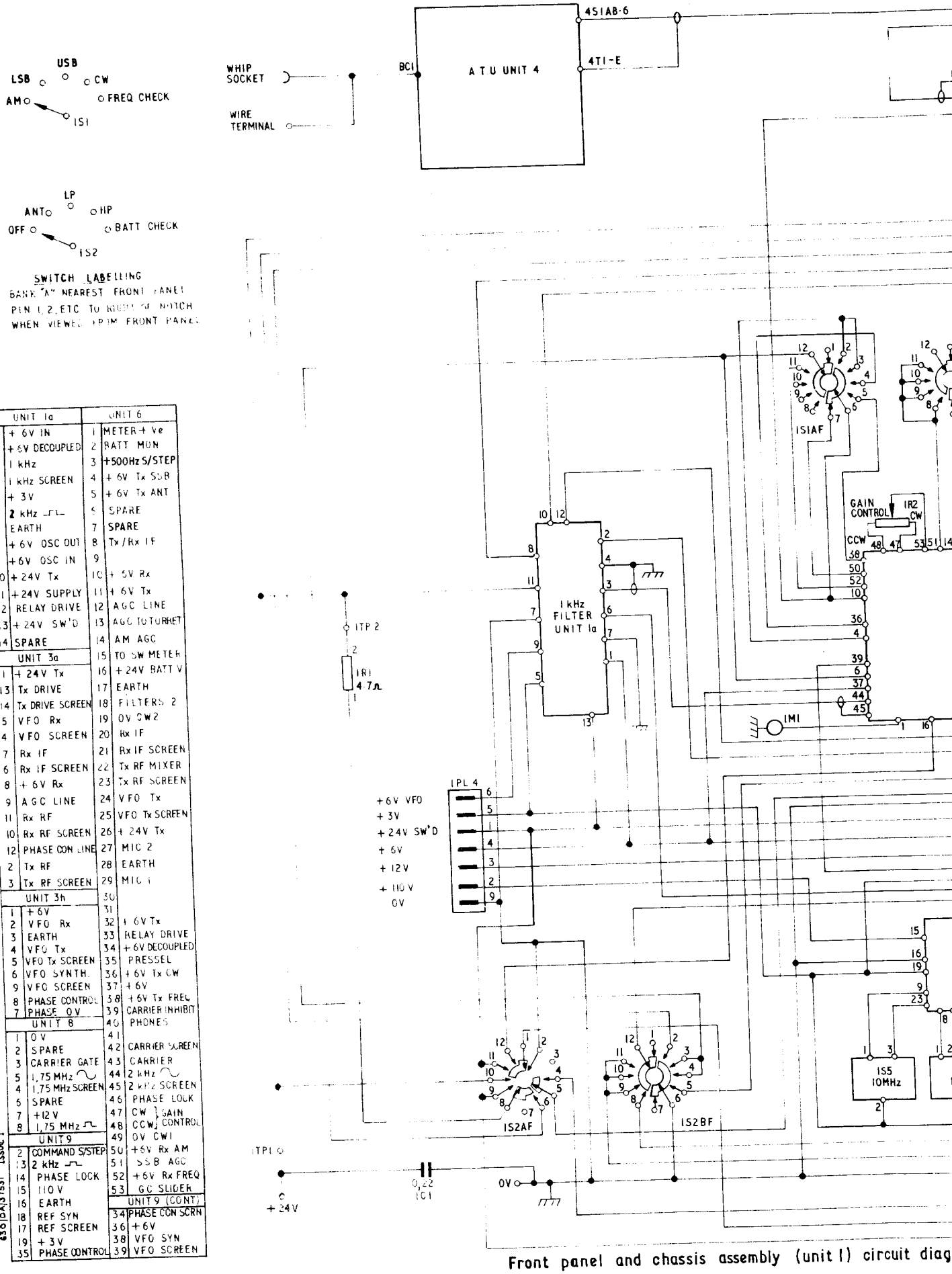


Fig. 1 Typical mounting of components on panels, electronic circuit



UNIT 1a	
1	+ 6V IN
2	+ 6V DECOUPLED
3	1 kHz
4	1 kHz SCREEN
5	+ 3V
6	2 kHz
7	EARTH
8	+ 6V OSC OUT
9	+ 6V OSC IN
10	+ 24V Tx
11	+ 24V SUPPLY
12	RELAY DRIVE
13	+ 24V SW'D
14	SPARE

UNIT 3a	
1	+ 24V Tx
13	Tx DRIVE
14	Tx DRIVE SCREEN
5	VFO Rx
4	VFO SCREEN
7	Rx IF
6	Rx IF SCREEN
8	+ 6V Rx
9	AGC LINE
11	Rx RF
10	Rx RF SCREEN
12	PHASE CON LINE
2	Tx RF
3	Tx RF SCREEN

UNIT 3b	
1	+ 6V
2	VFO Rx
3	EARTH
4	VFO Tx
5	VFO Tx SCREEN
6	VFO SYNTH.
9	VFO SCREEN
8	PHASE CONTROL
7	PHASE 0V

UNIT 8	
1	0 V
2	SPARE
3	CARRIER GATE
5	1.75 MHz
4	1.75 MHz SCREEN
6	SPARE
7	+ 12 V
8	1.75 MHz

UNIT 9	
2	COMMAND S/STEP
13	2 kHz
14	PHASE LOCK
15	110 V
16	EARTH
18	REF SYN
17	REF SCREEN
19	+ 3 V
35	PHASE CONTROL

UNIT 6	
1	METER + Ve
2	BATT MON
3	+500Hz S/STEP
4	+ 6V Tx SSB
5	+ 6V Tx ANT
6	SPARE
7	SPARE
8	Tx/Rx IF
9	
10	+ 6V Rx
11	+ 6V Tx
12	AGC LINE
13	AGC TO TURRET
14	AM AGC
15	TO SW METER
16	+ 24V BATT V
17	EARTH
18	FILTERS 2
19	0V SW2
20	Rx IF
21	Rx IF SCREEN
22	Tx RF MIXER
23	Tx RF SCREEN
24	VFO Tx
25	VFO Tx SCREEN
26	+ 24V Tx
27	MIC 2
28	EARTH
29	MIC 1
30	
31	
32	+ 6V Tx
33	RELAY DRIVE
34	+ 6V DECOUPLED
35	PRESSEL
36	+ 6V Tx CW
37	+ 6V
38	+ 6V Tx FREQ
39	CARRIER INHIBIT
40	PHONES
41	
42	CARRIER SCREEN
43	CARRIER
44	2 kHz
45	2 kHz SCREEN
46	PHASE LOCK
47	CW } GAIN
48	CCW } CONTROL
49	0V CW1
50	+6V Rx AM
51	SSB AGC
52	+6V Rx FREQ
53	GC SLIDER

UNIT 9 (CONT.)	
34	PHASE CON SCRN
36	+ 6V
38	VFO SYN
39	VFO SCREEN

630 DA/37531 Issue 1

Front panel and chassis assembly (unit 1) circuit diag

Fig.2
Issue 1

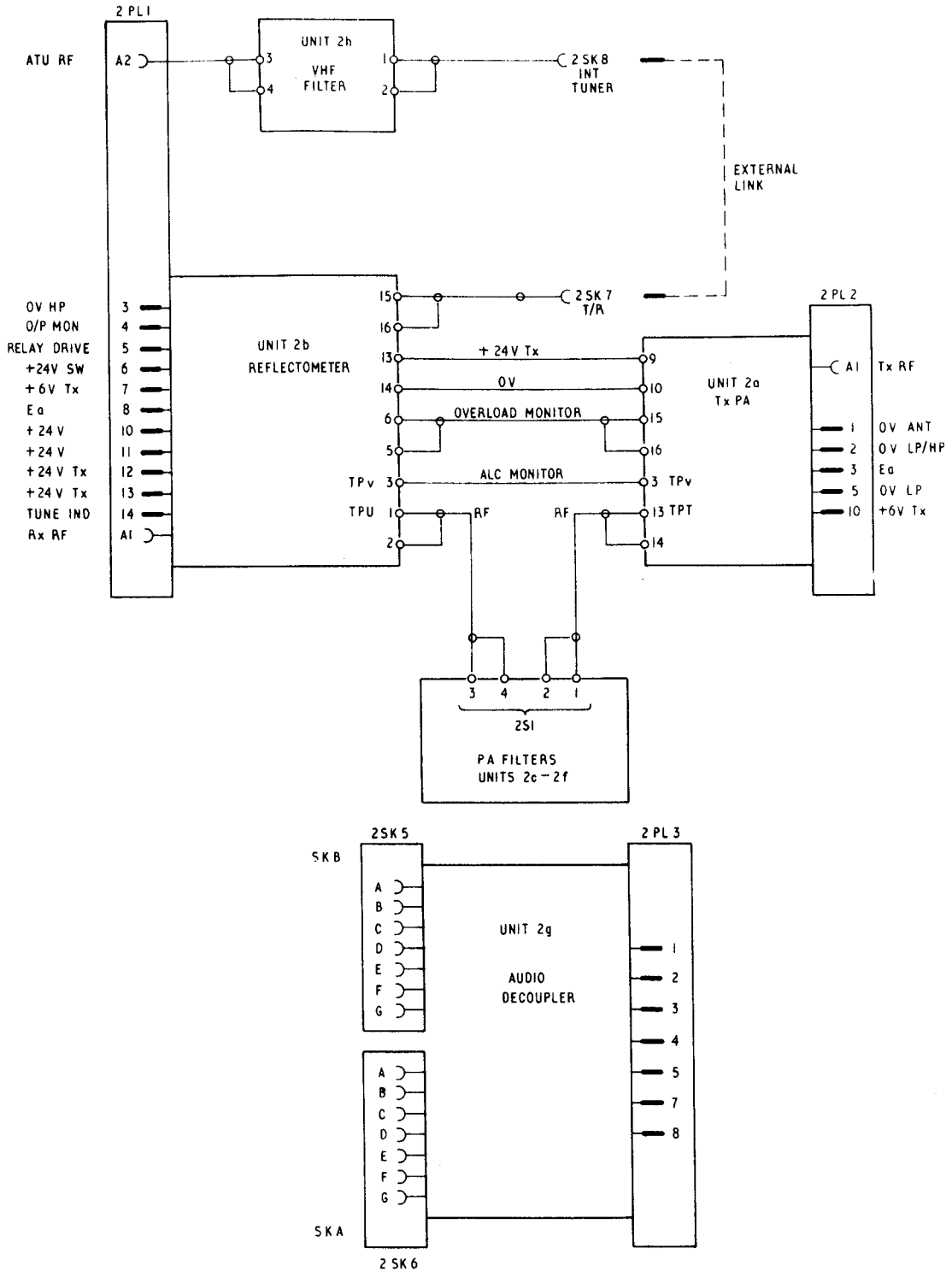


Fig.3 Unit 2 – Circuit diagram

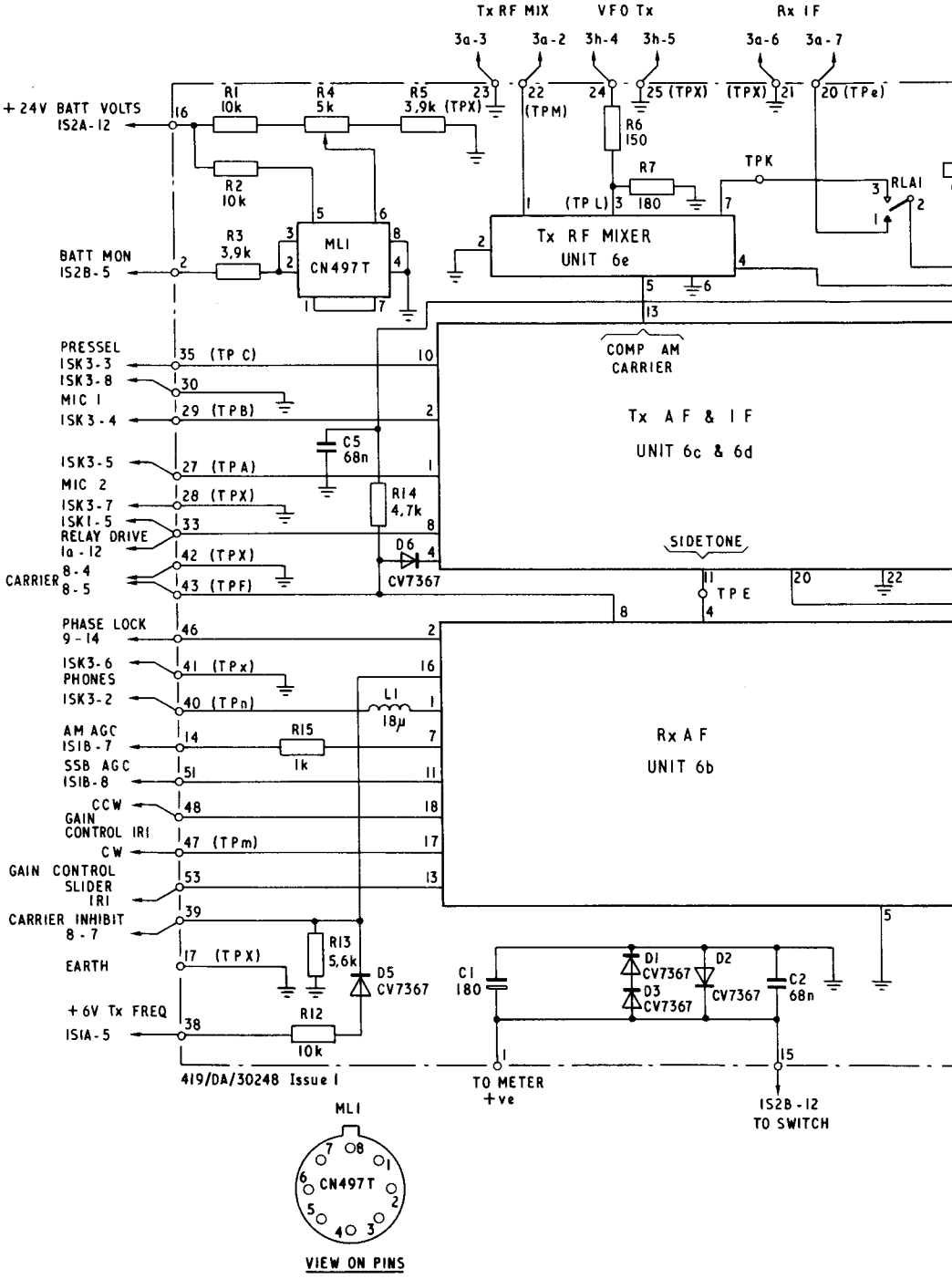


Fig 4

Issue 1

Unit 6, mother panel and units 6a to 6e

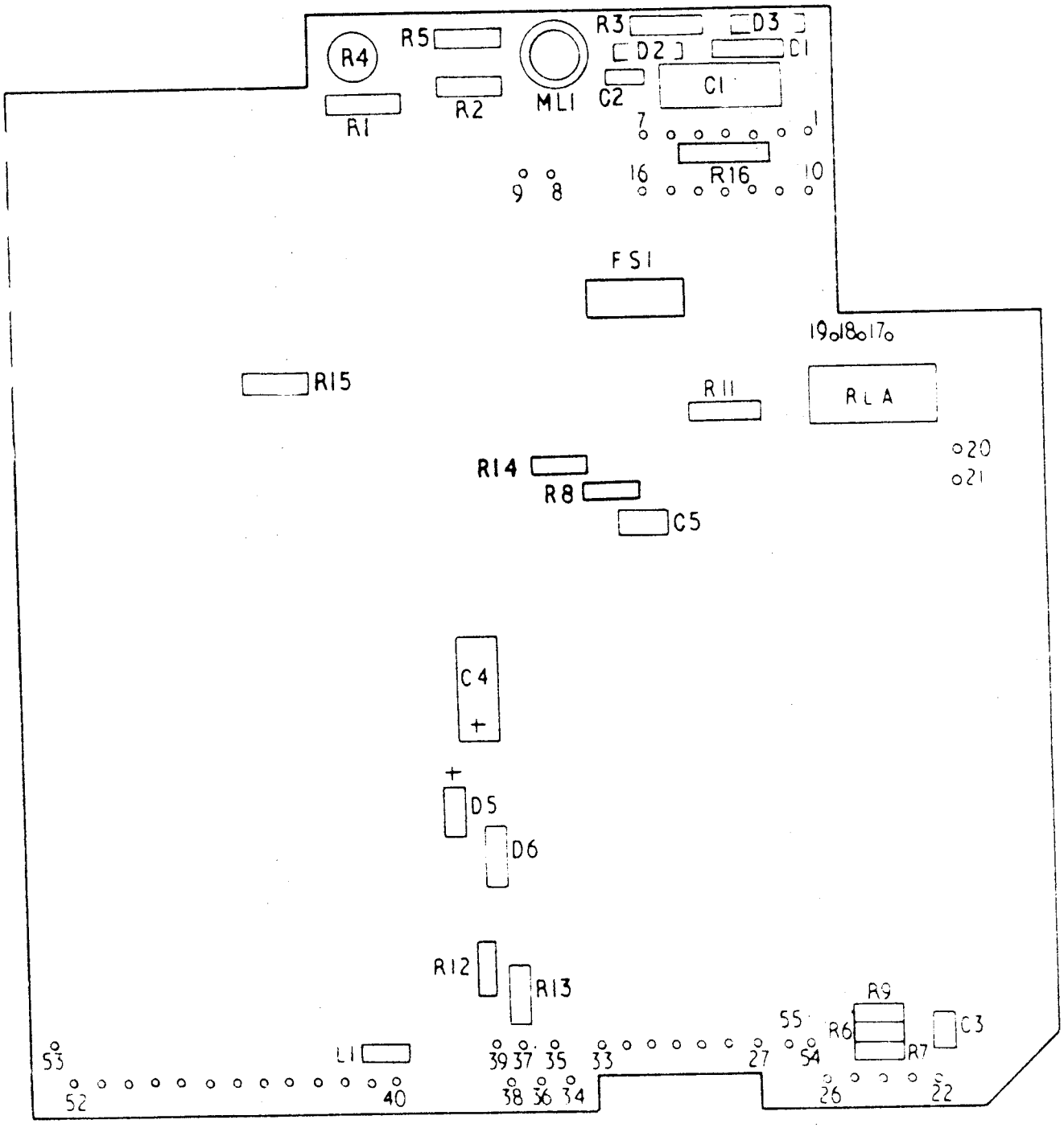


Fig 5 Unit 6 - component layout

THIRD LINE SERVICING

OF

FILTER UNIT 419/1/11815

(Unit 1a)

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ILLUSTRATIONS

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DESCRIPTION

1. The Filter Unit (Unit 1a) is a panel, electronic circuit (pec), which is a component part of the transmitter-receiver and is normally located on the Front Panel and Chassis Assembly (Unit 1).

2. With reference to the circuit diagram in Fig.1, Unit 1a provides the following:

(1) TR2 and associated components function as a filter which accepts a 2 kHz input square waveform of 100 mV peak-peak and filters this waveform to produce a 50 mV peak-peak 2 kHz sine wave.

(2) Surge protection of an external relay is provided by transistor TR3 (in parallel with the relay coil) and transistor TR1 (in parallel with the relay contacts). The relay drive signal operates TR3, thereby switching TR1. Since the transistors operate more rapidly than the relay, TR1 takes the initial surge and thereby protects the relay contacts. The maximum surge current is 4.5A.

(3) L2/C2 provides decoupling of the +6V supply for the VFO and L1 provides suppression for the +6V suppy to certain Tx and Rx circuits.

TESTING

3. Before unit 1a can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

COMPONENTS LIST

4. The principal component parts of the Filter Unit are listed below and the component layout is given on Fig.2.

Cct.Ref.	Description	Reference No.
Resistors		
R1	3.3k ohm ± 2% 0.25W	403/4/05523/330
R2	2k ohm ± 2% 0.25W	403/4/05523/200
R3	3.9k ohm ± 2% 0.25W	403/4/05523/390
R4	8.2k ohm ± 2% 0.25W	403/4/05523/820
R5	10k ohm ± 2% 0.25W	403/4/05524/100
R6	27k ohm ± 2% 0.25W	403/4/05524/270
R7	68 ohm ± 2% 0.25W	403/4/05521/680
R8	2.2k ohm ± 2% 0.25W	403/4/05523/220
R9	10k ohm ± 2% 0.25W	403/4/05524/100
R10	470 ohm ± 2% 0.25W	403/4/05522/470
R11	1k ohm ± 2% 0.25W	403/4/05523/100
Capacitors		
C1	82 nF ± 10% 100V	400/4/19494/820
C2	47 uF ± 10% 6V, electrolytic	402/4/55722/470
C3	39 nF ± 10% 100V	400/4/19494/390
C4	22 nF ± 10% 100V	400/4/19494/220
C5	10 nF ± 20% 100V	400/4/20544/100
C6	68 nF ± 20% 50V	400/4/20544/680
Inductors		
L1	Inductor A.F.	406/8/11032/004
L2	Inductor R.F.	406/9/08490/033
Semi-conductors		
TR1	Transistor BSV64	417/4/00247
TR2	Transistor ZTX 109	417/4/05092
TR3	Transistor BCY 70	417/4/01721/001
D1	Diode BAX 12	415/4/05451

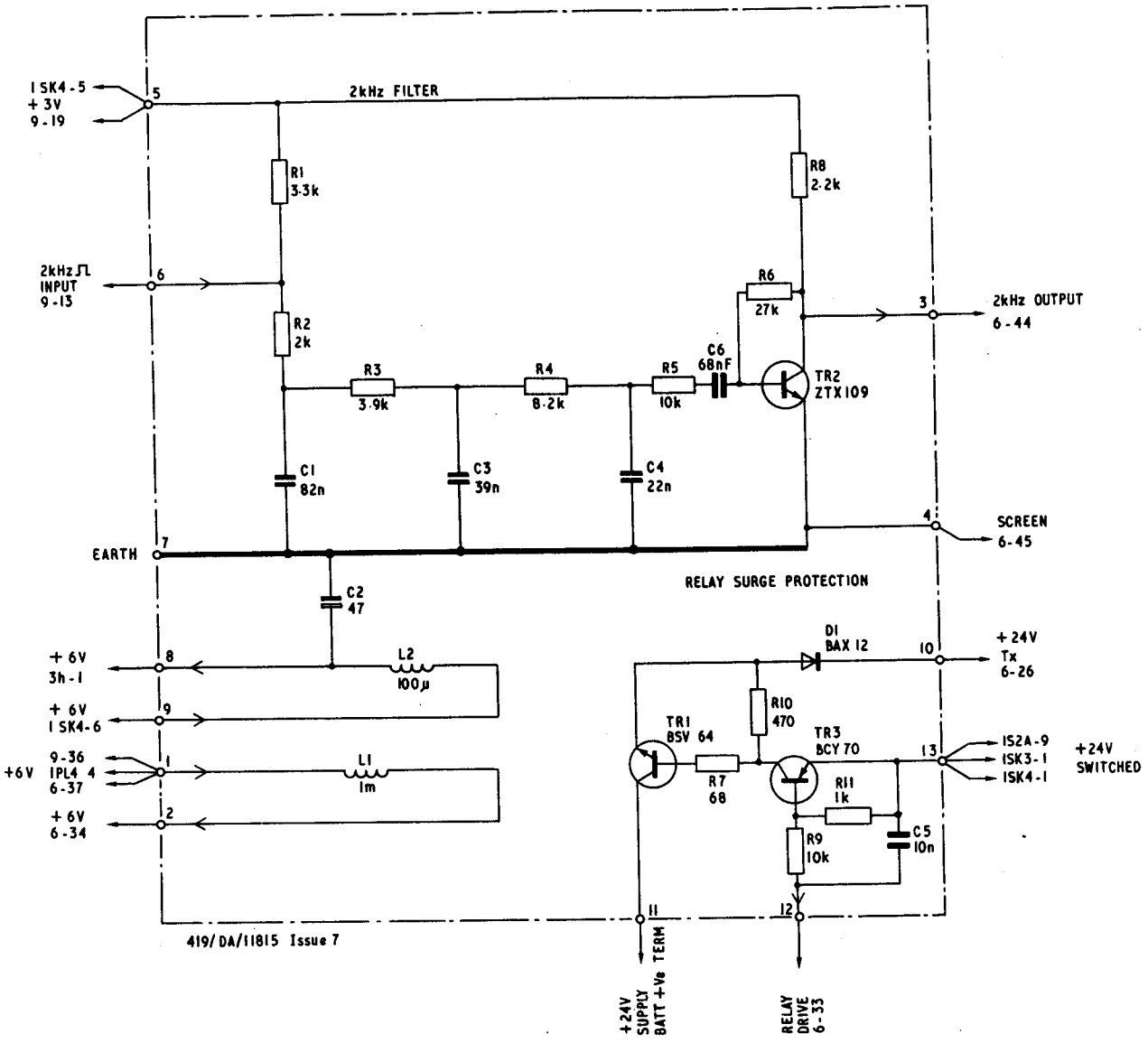

Fig. 1 2kHz filter (Unit 1a) - circuit diagram

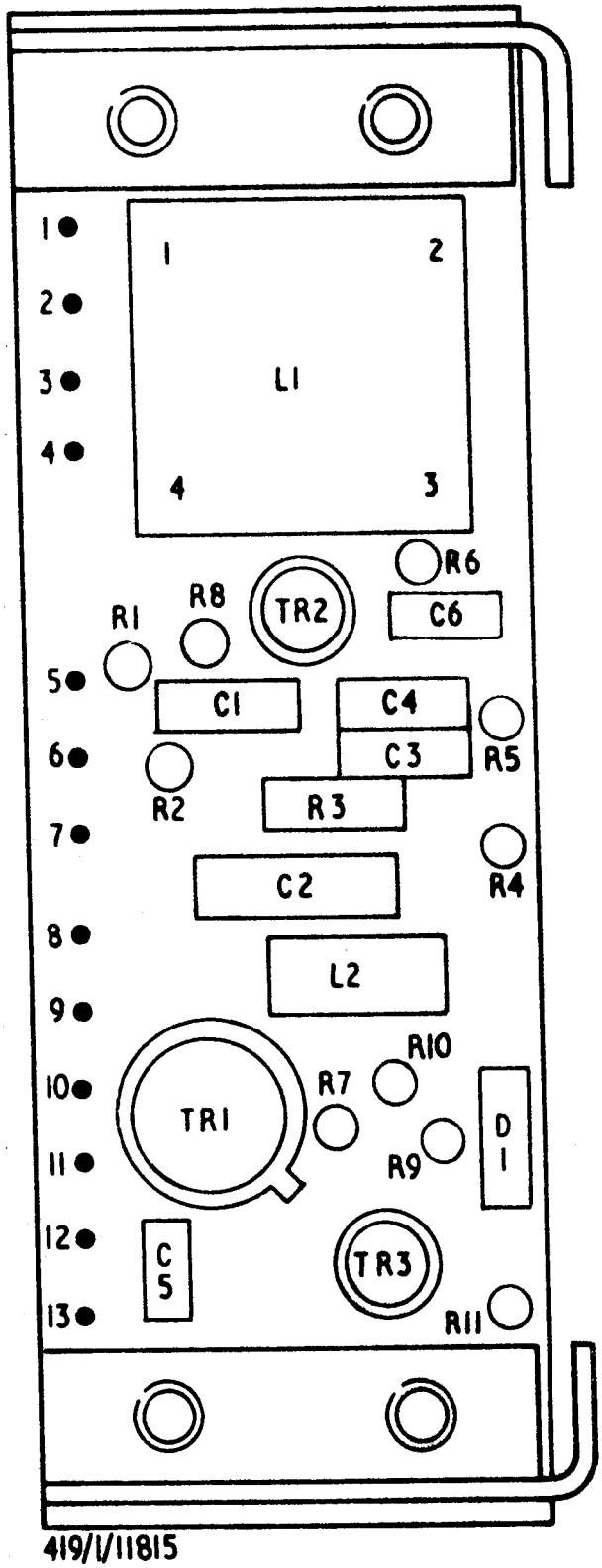

Fig. 2 Unit 1a - component layout

THIRD LINE SERVICING

OF

POWER AMPLIFIER 419/1/11820

(Unit 2a)

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WARNING

THE RF POWER TRANSISTORS IN UNIT 2a CONTAIN BERYLLIUM OXIDE MATERIAL WHICH, IF IMPROPERLY HANDLED, CAN CONSTITUTE A SERIOUS HAZARD TO HEALTH. REFER TO HEALTH HAZARD NOTICE AT THE BEGINNING OF THIS MANUAL.

INTRODUCTION

1. The Power Amplifier (Unit 2a) is a panel, electronic circuit (pec), which is a component part of the transmitter-receiver and is normally located on the Rear Panel Assembly (Unit 2).

2. Unit 2a provides:

(1) Power amplification of the transmitter RF signal.

(2) An automatic level control which maintains the transmitter output power at the correct level to suit the conditions of load VSWR, battery voltage, operating mode and demanded power (information defining load VSWR and output power is provided by the reflectometer (Unit 2b).

DETAILED DESCRIPTION

3. Unit 2a consists of a panel, electronic circuit together with a connector (2PL2). Wire leads connect 2PL2 to the panel, which contains RF power amplifiers, ALC generator and bias regulator circuits.

4. With reference to the circuit diagram in Figure 1. The power amplifiers consist of a class AB output stage (TR12/13), a class AB driver (TR6/7) and three class A pre-amplifier stages (ML2, TR2 and TR3/4).

5. ML2, the first pre-amplifier stage, is a silicon integrated circuit. The RF input at pin 5 of ML2 is the main signal path and this same input at pin 6 controls the bias level of the internal amplifier. A gain control signal is applied from pin 11 of the ALC generator ML1 to pin 7 of ML2. The amplified RF is taken from pin 3 of ML2 to the second pre-amplifier, TR2.

6. Bias for the driver stage is derived from the +6V supply by a "ring-of-two" regulator circuit (TR5/TR8). The bias level is set by resistor R34. Similarly, bias for the output stage is provided by the regulator TR9, TR10, TR11 and the bias level is set by resistor R43.

NOTE: Transistors TR11, 12 and 13 are located on a heat sink which is attached to the panel, electronic circuit.

7. The ALC generator ML1 compares an ALC control signal, supplied to pin 22 of ML1 from Unit 2b, with a standing reference voltage developed across an internal resistor chain and set by resistor R2. Since the control voltage is derived from the RF output and the ALC generator output controls the gain of the first RF pre-amplifier, a loop is formed which automatically maintains the peak-envelope-power at the appropriate level. When OV is applied to pin 2 of the panel, the standing reference voltage within ML1 is modified and the RF power level is reduced.

8. The ALC system has a fast attack time constant and a slow decay time constant to provide suitable control of peak-envelope-power without introducing excessive intermodulation. These time constants are provided by various components connected to ML2. The inputs, OV LP/HP and OV ANT TUNE are controlled by the power switch on the front panel of the radio and select the time constants appropriate to the required power level.

9. A delayed mean control limits the power output under continuous tone conditions to approx. 4 dB below peak-envelope-power to avoid excessive heat dissipation and power consumption.

10. Overload protection is provided by a control voltage applied to pins 16 and 17 of ML1. This voltage is provided by two sources, TR14 emitter in Unit 2a or via the panel pin 15 from Unit 2b. If either source causes the control voltage to exceed a level of 1.1V, a gating circuit within ML1 overrides the normal ALC control and the control voltage applied from ML1 to ML2 produces maximum attenuation in the first RF pre-amplifier.

11. The overload sensing circuit within Unit 2a operates as follows. The voltage developed across R45 is the resultant of two anti-phase voltages, one is derived from the RF output current flowing through the primary of current transformer T5 and the other is derived from the RF output voltage at transformer T4. When the load is correctly matched, the two voltages are equal, the resultant across R45 is zero and a minimum output is obtained from the emitter follower TR14. A mismatched load will result in an imbalance of the two voltages, giving a resultant which increases with the degree of mismatch.

TESTING

12. Before Unit 2a can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

FAULT FINDING

13. The information in Tables 1 and 2 is intended to aid diagnosis of the location of a fault; it provides the nominal voltage at designated points, related to specific test conditions as obtained in the relevant test configuration in Part 4.

Table 1

Unit 2a - Typical d.c. voltages

Test conditions as at last step of "set PA bias and driver bias" test (2aR34, 2aR43 adjusted).

Voltages measured w.r.t. Unit 2a pin 1 (earth).

ML1 pin	Volts
1	0
2,5	3.4
3,6	0
4	4.1
7	5.1
8,19	4.1
9	0.7
10	1.1
11	0.3
12	0

ML1 pin	Volts
13	0
14	0
15	6.0
16,17	1.1
18	2.1
20	0
21	1.5
22	2.1
23,24	1.9

For ML2 pin	Measure at	Volts
2	L3	6.0
3	R10	1.7
5,6	C10	0.9
7	ML1/11	0.3
-	TPP	1.7
	TR5b/R31	1.8
	Pin 11)	1.85
	TR10b)	
	TR3e	0.35
	TR4e	0.35

Table 2

Unit 2a - Typical r.f. voltages

Test conditions as at last step of "ALC adjustment" tests (2aR2 at final setting with RF Gen O/P level 100 mV).

Voltages measured w.r.t. Unit 2a pin 14 (r.f. earth).

Measure at	r.f. Volts
TPN	0.065
TPP	0.090
TPR	0.40
TPS	0.40
T3 Pin 1	2.0
T3 Pin 3	2.0
T4 Pin 4	10.0
T4 Pin 6	10.0

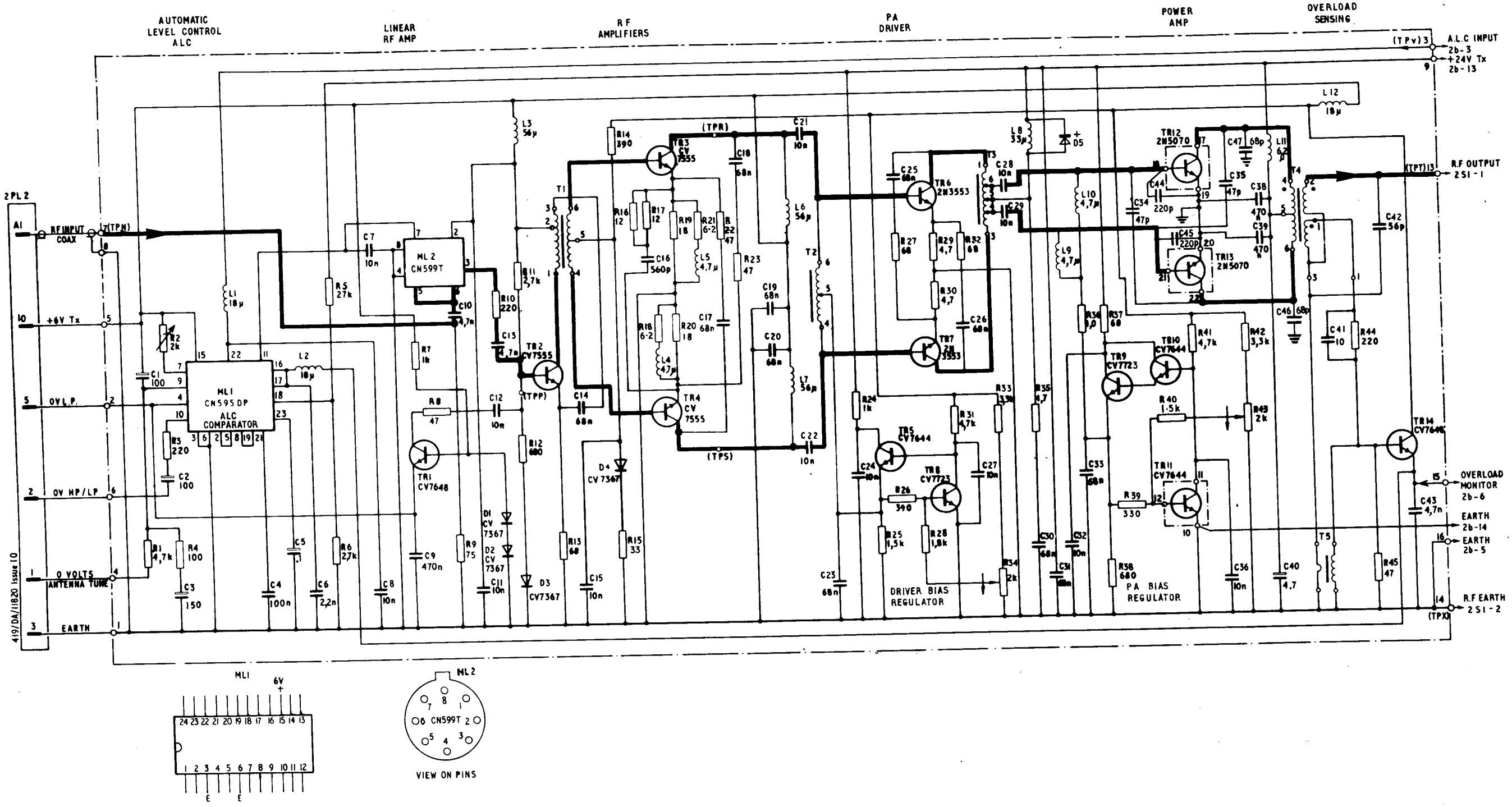
COMPONENTS LIST

14. The principal component parts of Unit 2a are listed below and the component layout of the unit is given in Figs 2,3.

Cct.Ref.	Description	Reference No.
Resistors		
R1	4.7k ohm ± 2% 0.25W	403/4/05523/470
R2	2k ohm ± 10% 0.5W variable	404/9/05032/004
R3	220 ohm ± 2% 0.25W	403/4/05522/220
R4	100 ohm ± 2% 0.25W	403/4/05522/100
R5	27k ohm ± 1% 0.25W	403/4/05514/270
R6	2.7k ohm ± 1% 0.25W	403/4/05513/270
R7	1k ohm ± 2% 0.25W	403/4/05523/100
R8	47 ohm ± 2% 0.25W	403/4/05521/470
R9	75 ohm ± 2% 0.25W	403/4/05521/750
R10	220 ohm ± 2% 0.25W	403/4/05522/220
R11	2.7k ohm ± 2% 0.25W	403/4/05523/270
R12	680 ohm ± 2% 0.25W	403/4/05522/680
R13	68 ohm ± 2% 0.25W	403/4/05521/680
R14	390 ohm ± 2% 0.25W	403/4/05522/390
R15	33 ohm ± 2% 0.25W	403/4/05521/330
R16,17	12 ohm ± 2% 0.25W	403/4/05521/120
R18	6.2 ohm ± 2% 0.4W	403/9/05026/001
R19,20	18 ohm ± 2% 0.25W	403/4/05521/180
R21	6.2 ohm ± 2% 0.4W	403/9/05026/001
R22,23	47 ohm ± 2% 0.25W	403/4/05521/470
R24	1k ohm ± 2% 0.25W	403/4/05523/100
R25	1.5k ohm ± 2% 0.25W	403/4/05523/150
R26	390 ohm ± 2% 0.25W	403/4/05522/390
R27	68 ohm ± 2% 0.25W	403/4/05521/680
R28	1.8k ohm ± 2% 0.25W	403/4/05523/180
R29,30	4.7 ohm ± 5% 0.5W	403/9/03540/002
R31	4.7k ohm ± 2% 0.25W	403/4/05523/470
R32	68 ohm ± 2% 0.25W	403/4/05521/680
R33	3.3k ohm ± 2% 0.25W	403/4/05523/330
R34	2k ohm ± 10% 0.5W variable	404/9/05032/004
R35	4.7 ohm ± 5% 0.5W	403/9/03540/002
R36	1.0 ohm ± 10% 0.5W	403/9/03540/001
R37	68 ohm ± 5% 6W wirewound	403/4/04001/680
R38	680 ohm ± 2% 0.25W	403/4/05522/680
R39	330 ohm ± 2% 0.25W	403/4/05522/330
R40	1.5k ohm ± 2% 0.25W	403/4/05523/150
R41	4.7k ohm ± 2% 0.25W	403/4/05523/470
R42	3.3k ohm ± 2% 0.25W	403/4/05523/330
R43	2k ohm ± 10% 0.5W variable	404/9/05032/004
R44	220 ohm ± 2% 0.25W	403/4/05522/220
R45	47 ohm ± 2% 0.25W	403/4/05521/470

Cct.Ref.	Description	Reference No.
Capacitors		
C1,2	100 uF ± 10% 10V electrolytic	402/4/56303/100
C3	150 uF ± 10% 6V electrolytic	402/4/55723/150
C4	100 nF ± 20% 100V	400/4/20475/100
C5	100 nF ± 10% 100V	400/9/19486/001
C6	2.2 nF ± 10% 100V	400/4/19313/220
C7,8	10 nF ± 20% 100V	400/4/20564/100
C9	470 nF ± 20% 50V	400/4/20495/470
C10	4.7 nF ± 20% 100V	400/4/20543/470
C11,12	10 nF ± 20% 100V	400/4/20544/100
C13	4.7 nF ± 20% 100V	400/4/20543/470
C14	68 nF ± 20% 50V	400/4/20544/680
C15	10 nF ± 20% 100V	400/4/20544/100
C16	560 pF ± 10% 100V	400/4/19482/560
C17 to 20	68 nF ± 20% 50V	400/4/20544/680
C21,22	10 nF ± 20% 100V	400/4/20544/100
C23	68 nF ± 20% 50V	400/4/20544/680
C24	10 nF ± 20% 100V	400/4/20544/100
C25,26	68 nF ± 20% 50V	400/4/20544/680
C27	10 nF ± 20% 100V	400/4/20544/100
C28,29	10 nF ± 20% 100V	400/4/20564/100
C30,31	68 nF ± 20% 50V	400/4/20544/680
C32	10 nF ± 20% 100V	400/4/20544/100
C33	68 nF ± 20% 50V	400/4/20544/680
C34,35	47 pF ± 5% 100V	400/4/19301/470
C36	10 nF ± 20% 100V	400/4/20544/100
C37	Not used	
C38,39	470 nF ± 20% 50V	400/4/20495/470
C40	4.7 uF ± 10% 35V electrolytic	402/4/56321/470
C41	10 pF ± 5% 100V	400/4/19301/100
C42	56 pF ± 10% 350V	424/4/98027/016
C43	4.7 nF ± 20% 100V	400/4/20543/470
C44,45	220 pF ± 5% 100V	400/4/19302/220
C46,47	68 pF ± 10% 100V	400/4/19491/680
Inductors		
L1,2	Inductor 18 uH ± 10%	406/9/08470/027
L3	Inductor 56 uH ± 10%	406/9/08490/030
L4,5	Inductor 4.7 uH ± 10%	406/9/08470/020
L6,7	Inductor 56 uH ± 10%	406/9/08490/030
L8	Inductor 33 uH ± 10%	406/9/26031
L9,10	Inductor 4.7 uH ± 10%	406/9/08470/020
L11	Inductor 6.2 uH ± 10%	406/8/11123
L12	Inductor 18 uH	406/9/08450/024
Semi-conductor devices		
TR1	Transistor C648 (BSY95A)	417/4/98681
TR2 to 4	Transistor C555	417/4/00496/004
TR5	Transistor BC107	417/4/02028/001
TR6,7	Transistor 2N 3553	417/4/01799
TR8,9	Transistor BFY51	417/4/01737/002

Cct.Ref.	Description	Reference No.
Semi-conductor devices (cont'd)		
TR10,11	Transistor BC107	417/4/02028/001
TR12,13	Transistor 2N 5070	417/4/00248
TR14	Transistor C648 (BSY95A)	417/4/98681
D1 to 5	Diode C756, IN4148	415/4/98869
ML1	Integrated circuit CN595 D.P.	446/4/00452
ML2	Integrated circuit CN599T	446/4/00421
Transformers		
T1	Transformer	406/8/11031/004
T2	Transformer	406/8/11031/005
T3	Transformer	406/8/11031/006
T4	Transformer	406/8/11032/006
T5	Transformer	406/8/11099
Miscellaneous		
2PL2	Plug, electrical	508/9/21629
A1	Socket, elect., co-ax (insert for 2PL2)	508/9/20404
	Heat sink assembly	640/1/14919
	Heat sink adaptor TO-5	418/9/37021/002
	Heat sink adaptor TO-18	418/9/37022/002
	Nut 10-32 UNF st.st.	991/4/00474/014



Power amplifier (Unit 2a)-circuit

Fig.1

Issue 3

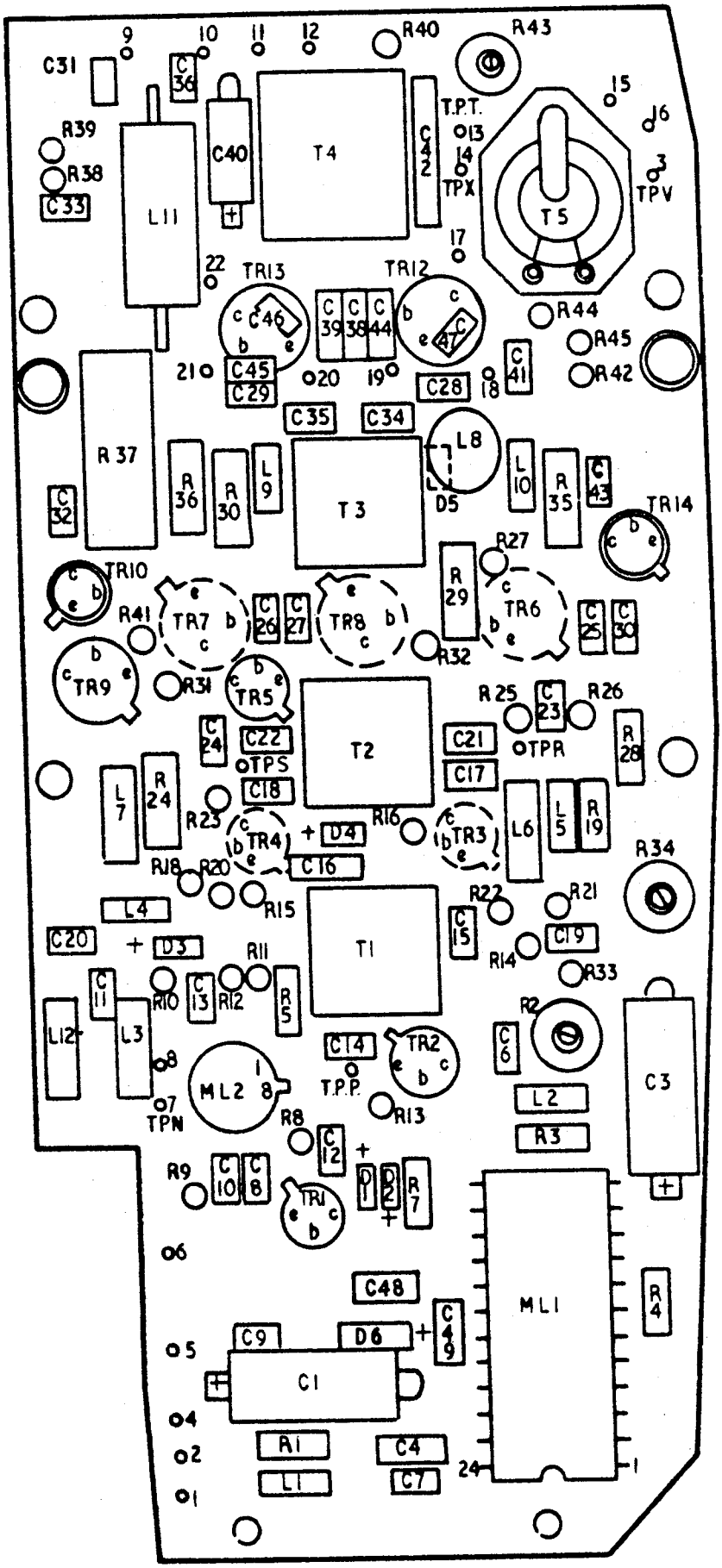
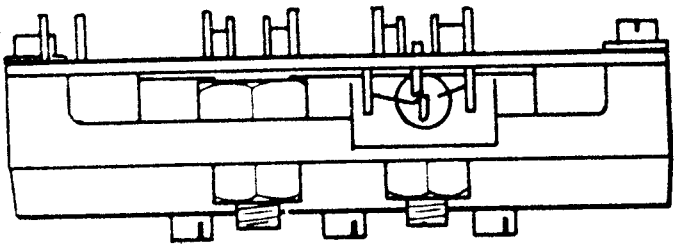


Fig.2 Power amplifier pec(unit 2a)
component layout



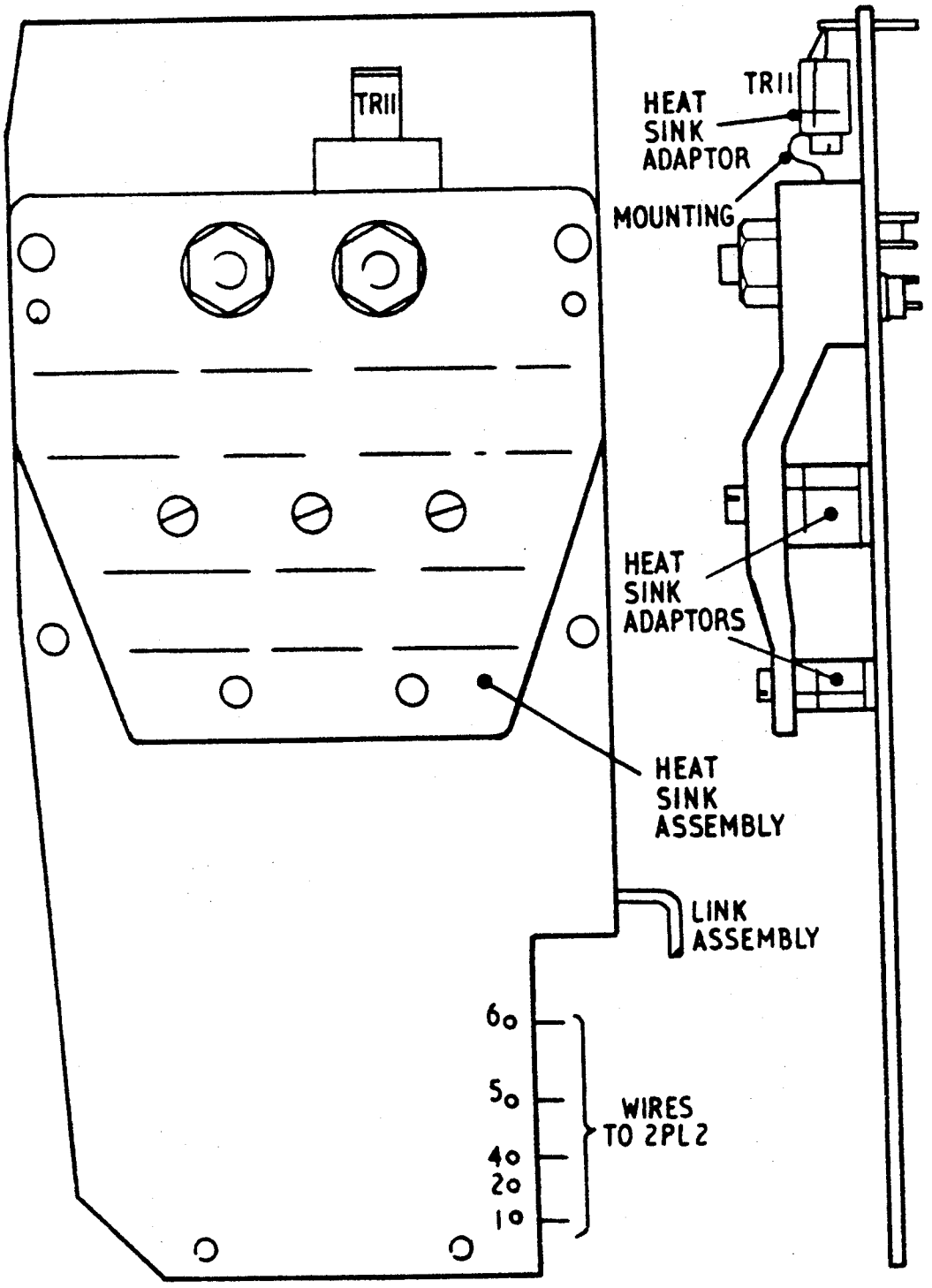


Fig.3 Power amplifier-position of heat sinks

THIRD LINE SERVICING

OF

REFLECTOMETER 419/1/11830

(Unit 2b)

CONTENTS

	Para.
Introduction	1
Detailed Description	
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ILLUSTRATIONS

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2	Reflectometer pec (Unit 2b) - component layout	7

INTRODUCTION

1. The Reflectometer (Unit 2b) is a component part of the receiver-transmitter and is normally located on the Rear Panel Assembly (Unit 2). It consists of a panel, electronic circuit together with a connector (2PL1). Wire leads connect 2PL1 to the panel, which provides the following circuits:

(1) A reflectometer that produces voltages which indicate whether the transmitter power amplifier is correctly terminated with a 50 ohm impedance or not. Two voltages are produced:

(a) Tune indicator. This is for supply to a small indicating meter and is maximum when the PA is correctly terminated.

(b) Overload monitor. This is for supply to the PA protection circuits and is minimum when the PA is correctly terminated.

(2) An RF output monitor which produces a voltage suitable for supply to a small indicating meter and which is proportional to the transmitter antenna circuit.

(3) An output monitor (ALC drive) which produces a voltage proportional to the transmitter RF output voltage. Any audio modulation present in the Tx output is reflected to the output of the monitor.

(4) A relay for Tx/Rx switching.

DETAILED DESCRIPTION (refer to Fig.1)

Tx/Rx Relay RLA

2. The relay is operated from the 24V supply, its contacts provides the +24V Tx supply, and switching of RF path to or from socket 2SK7.

Reflectometer

3. Two opposing voltages developed across resistor R3 are respectively proportional to the RF input voltage and current; these voltages are provided by the auto transformer AUT1 and the secondary of the current transformer CT1. The resultant RF voltage is applied to the rectifier D4 and, reduced in level by auto transformer AUT2, to the rectifier D5. When the RF load is 50 ohms, the voltages across R3 balance and the resultant (and the rectifier outputs) approaches OV. A mismatched load will result in an imbalance of the voltages, giving a resultant which increases with the degree of mismatch.

4. The RF rectified by D4 provides a negative bias potential to the base of transistor TR1, the emitter current of which provides the tune indicator output via pin 10 (2PL1/14). When the RF load is 50 ohms, the negative bias applied to TR1 from D4 is minimum (OV nominal) and the resulting output from pin 10 (2PL1/14) is maximum (0.85V dc nominal).

5. The RF rectified by D5 provides a positive potential at the overload monitor output from pin 6; this output is minimum (OV nominal) when the RF load is 50 ohms.

ALC Drive

6. One transistor in ML1, in conjunction with capacitor C7, provides an RF level detector that produces a dc output at pin 3 which is proportional to the RF input voltage level. This output has a standing level of +2V dc, due to the second transistor in ML1, and is increased by the detector output.

7. There is no audio decoupling in this circuit and any audio modulation in the transmitter output will pass to the output.

Antenna Current Monitor

8. The RF at transformer AUT1 secondary is rectified by diode D1, to provide the output monitor voltage which is taken to an external meter via pin 7 (2PL1/14).

9. The sensitivity of the circuit is reduced when the radio is operating in the high power mode by connecting pin 8 (2PL1/3) to OV.

TESTING

10. Before Unit 2b can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

FAULT FINDING

11. The information given below is intended to aid diagnosis of the location of a fault; it provides nominal voltage levels between designated points with the test conditions applicable to the start of the "reflectometer sensitivity" test, as obtained in the relevant test configuration given in Part 4.

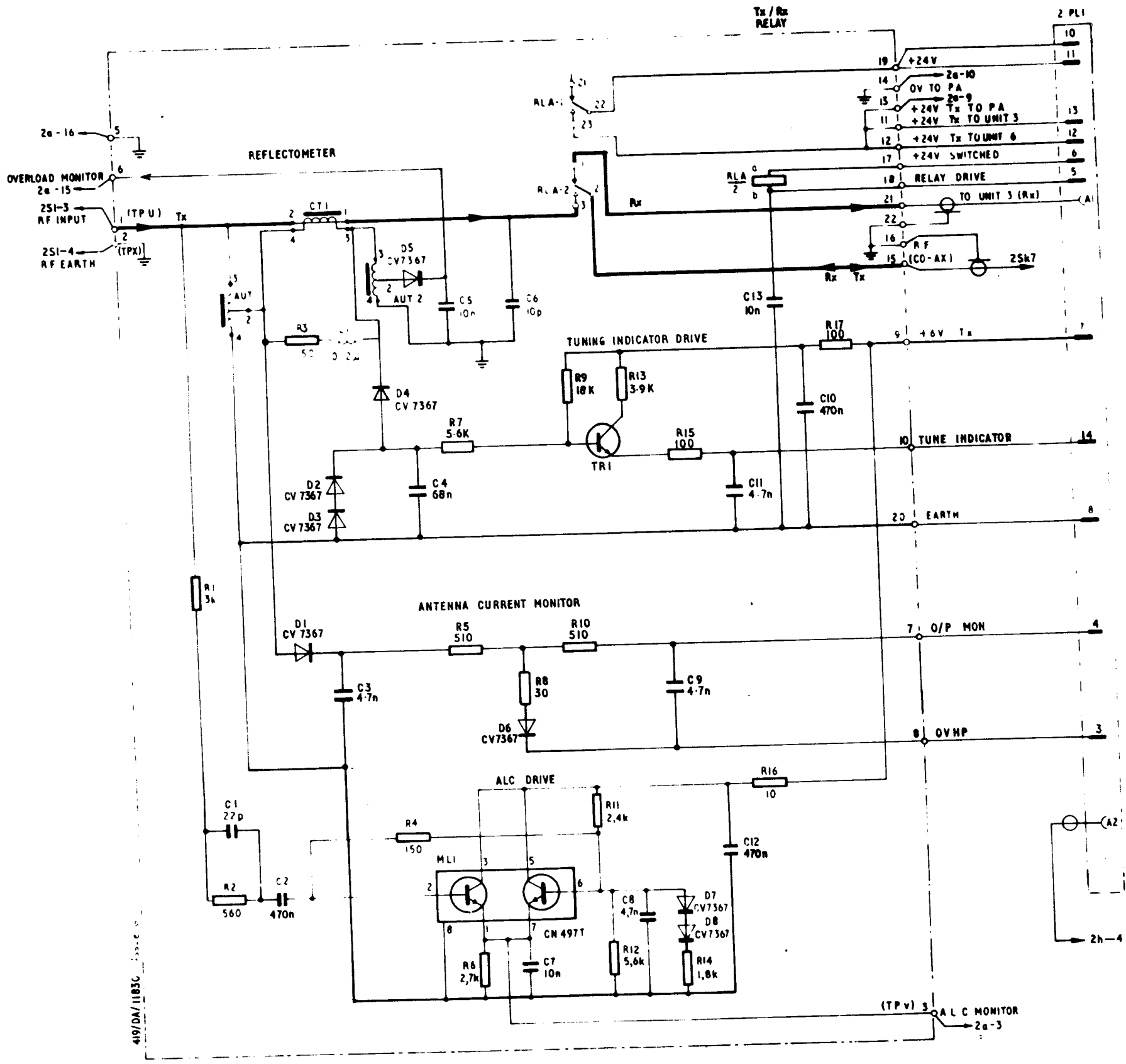
Measure at*	Volts d.c.
ML1/1,7	1.8
ML1/2	2.6
ML1/3	6.0
ML1/5	6.0
ML1/6	2.6
TR1b	1.6
TR1e	1.0

*with respect to Unit 2b pin 20 (Earth)

COMPONENTS LIST

12. The principal component parts of Unit 2b are listed on the following page and the component layout is given on Fig.2.

Cct.Ref.	Description	Reference No.
Resistors		
R1	4k ohm ± 1% 0.25W	403/4/05513/400
R2	560 ohm ± 1% 0.25W	403/4/05512/560
R3	150 ohm ± 1% 0.5W	403/4/05312/150
R4	150 ohm ± 2% 0.25W	403/4/05522/150
R5	510 ohm ± 2% 0.25W	403/4/05522/510
R6	2.7k ohm ± 2% 0.25W	403/4/05523/270
R7	5.6k ohm ± 2% 0.25W	403/4/05523/560
R8	30 ohm ± 2% 0.25W	403/4/05521/300
R9	18k ohm ± 2% 0.25W	403/4/05523/180
R10	510 ohm ± 2% 0.25W	403/4/05522/510
R11	2.4k ohm ± 1% 0.25W	403/4/05513/240
R12	5.6k ohm ± 1% 0.25W	403/4/05513/560
R13	3.9k ohm ± 2% 0.25W	403/4/05523/390
R14	1.8k ohm ± 1% 0.25W	403/4/05513/180
R15	100 ohm ± 2% 0.25W	403/4/05522/100
R16	10 ohm ± 2% 0.25W	403/4/05521/100
R17	100 ohm ± 2% 0.25W	403/4/05522/100
Capacitors		
C1	22 pF ± 5% 100V	400/4/19301/220
C2	10 nF ± 20% 100V	400/4/20544/100
C3	4.7 nF ± 20% 100V	400/4/20543/470
C4	68 nF ± 20% 50V	400/4/20544/680
C5	10 nF ± 20% 100V	400/4/20544/100
C6	10 pF ± 5% 100V	400/4/19301/100
C7	10 nF ± 20% 100V	400/4/20544/100
C8,9	4.7 nF ± 20% 100V	400/4/20543/470
C10	470 nF ± 20% 50V	400/4/20495/470
C11	4.7 nF ± 20% 100V	400/4/20543/470
C12	470 nF ± 20% 50V	400/4/20495/470
C13	10 nF ± 20% 100V	400/4/20544/100
Inductors		
L1	Inductor, 0.12 uH	406/9/08470/001
Semi-conductor devices		
ML1	Integrated circuit CN 497T	446/4/00429
TR1	Transistor C648 (BSY95A)	417/4/98681
D1 to 8	Diode C756	415/4/98869
Miscellaneous		
RLA	Relay	507/9/05095
2PL1	Plug, electrical	508/9/21630
A1,2	Socket, elect, co-ax (inserts for 2PL1)	508/9/20404
CT1	Transformer	406/8/11030/003
AUT1	Transformer	406/8/11030/004
AUT2	Transformer	406/8/11030/006



Reflectometer (unit 2b) - circuit

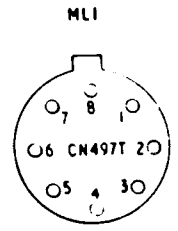


Fig.1
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Fig 1
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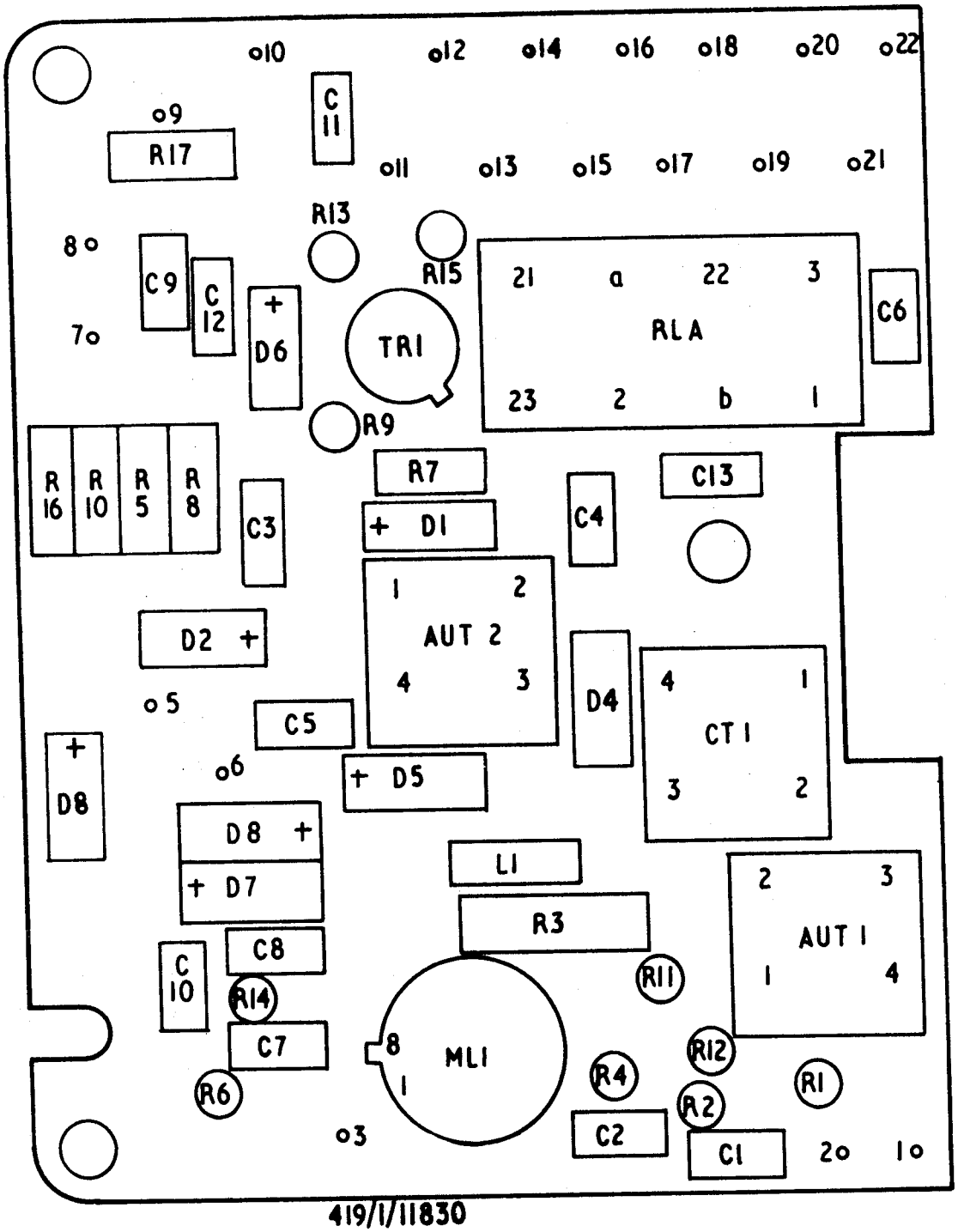

Note: Plug 2PL1 is part of this item and connects to it by flying leads

Fig 2 Reflectometer pec (unit 2b) component layout

THIRD LINE SERVICING

OF

PA FILTER SUB-ASSEMBLY 640/1/09734

(Units 2c-2f)

CONTENTS

	Para.
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ILLUSTRATIONS

Fig.		Page
1	PA Switch and Filter - circuit diagram	5
2	PA Filter - circuit diagram	7
3	Scrap view showing location of Principal Components	9
4	Units 2c-2f - component layout	11

INTRODUCTION

1. The PA filter assembly consists of a switch and four panels, electronic circuit (Units 2c-2f). It is a component part of the receiver-transmitter and is normally located on the Rear Panel Assembly (Unit 2).

NOTE: Literally, the PA filter assembly is a component part of the PA switch and filter assembly (630/1/09631). For convenience, a breakdown of this assembly is included in the components list at the rear of this section.

2. The assembly is connected in series with the transmitter output, the harmonic content of which is reduced by one of six filters, selected according to the frequency range.

DETAILED DESCRIPTION

3. The four panels respectively contain one filter on each of Units 2c and 2e and two filters on each of Units 2d and 2f. The panels are fixed in the form of a rectangular block, with six position printed circuit switches placed at the ends. A shaft links the switches. Two coaxial flying leads connect the assembly to the external circuits.

4. A circuit diagram of the assembly is given in Fig.1. Each filter (Fig.2) is a two-section, low pass, Darlington type configuration. The value of com-

ponents differ in each filter to provide the following characteristics:

	Pass-band	Stop-band edge frequency
Range 1 filter	2 - 3.1 MHz	4.0 MHz
Range 2 filter	3.1 - 4.9 MHz	6.2 MHz
Range 3 filter	4.9 - 7.7 MHz	9.8 MHz
Range 4 filter	7.7 - 12.2 MHz	15.4 MHz
Range 5 filter	12.2 - 19.1 MHz	24.4 MHz
Range 6 filter	19.1 - 30.0 MHz	38.2 MHz

5. In each case, the rejection band attenuation is greater than 25 dB with a pass-band insertion loss of less than 0.05 dB.

TESTING

6. Before the PA filter sub-assembly can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

COMPONENTS LIST

7. The PA Switch and Filter Assembly 640/1/09631 comprises:

Panel, electronic circuit (Unit 2b)	419/1/11830
Housing assembly	640/1/09735
Cover (over Unit 2b)	640/1/09733
PA Filter sub-assembly	640/1/09734
Cover (over filters)	640/2/09729
Shaft	640/2/09845
Circlip	999/4/01348/009

8. The Filter sub-assembly 640/1/09734 (refer to Fig.3) comprises:

Switch 2S1BF	408/8/23235
Switch 2S1AF	408/8/23234
Panel, electronic circuit (Unit 2c)	419/1/11835
Panel, electronic circuit (Unit 2d)	419/1/11840
Panel, electronic circuit (Unit 2e)	419/1/11845
Panel, electronic circuit (Unit 2f)	419/1/11850

Component layout diagrams of Units 2c to 2f are given in Fig.4 and associated component lists in paras.9-12 inc.

9. The component parts of Unit 2c, 419/1/11835 are:

Cct.Ref.	Description	Reference No.
Capacitors, silver mica		
C1	890 pF ± 0.5% 350V	424/4/98027/138
C2	264 pF ± 0.5% 350V	424/4/98027/129
C3	1497 pF ± 0.5% 350V	424/4/98027/140
C4	854 pF ± 0.5% 350V	424/4/98027/137
C5	641 pF ± 0.5% 350V	424/4/98027/136
Inductors, r.f.		
L1	2.04 - 2.38 uH min.	406/8/11037/001
L2	1.37 - 1.61 uH min.	406/8/11037/002

10. The component parts of Unit 2d, 419/1/11840 are:

Cct.Ref.	Description	Reference No.
Capacitors, silver mica		
C1	614 pF ± 0.5% 350V	424/4/98027/135
C2	394 pF ± 0.5% 350V	424/4/98027/132
C3	175 pF ± 0.5% 350V	424/4/98027/124
C4	106 pF ± 0.5% 350V	424/4/98027/119
C5	936 pF ± 0.5% 350V	424/4/98027/139
C6	603 pF ± 0.5% 350V	424/4/98027/134
C7	573 pF ± 0.5% 350V	424/4/98027/133
C8	344 pF ± 0.5% 350V	424/4/98027/130
C9	392 pF ± 0.5% 350V	424/4/98027/143
C10	258 pF ± 0.5% 350V	424/4/98027/128
Inductors, r.f.		
L1	1.29 - 1.51 uH min.	406/8/11037/003
L2	0.94 - 1.10 uH min.	406/8/11037/004
L3	0.80 - 0.94 uH min.	406/8/11037/005
L4	0.53 - 0.62 uH min.	406/8/11037/006

11. The component parts of Unit 2e, 419/1/11845 are:

Cct.Ref.	Description	Reference No.
Capacitors, silver mica		
C1	247 pF ± 0.5% 350V	424/4/98027/127
C2	70 pF ± 0.5 pF 350V	424/4/98027/116
C3	376 pF ± 0.5% 350V	424/4/98027/131
C4	230 pF ± 0.5% 350V	424/4/98027/125
C5	158 pF ± 0.5% 350V	424/4/98027/123
Inductors, r.f.		
L1	0.505 - 0.595 uH min.	406/8/11037/007
L2	0.353 - 0.384 uH min.	406/8/11037/008

12. The component parts of Unit 2f, 419/1/11850 are:

Cct.Ref.	Description	Reference No.
Capacitors, silver mica		
C1	157 pF ± 0.5% 350V	424/4/98027/122
C2	100 pF ± 0.5% 350V	424/4/98027/142
C3	45 pF ± 0.5 pF 350V	424/4/98027/114
C4	29 pF ± 0.5 pF 350V	424/4/98027/141
C5	240 pF ± 0.5% 350V	424/4/98027/126
C6	153 pF ± 0.5% 350V	424/4/98027/121
C7	147 pF ± 0.5% 350V	424/4/98027/120
C8	94 pF ± 0.5 pF 350V	424/4/98027/117
C9	101 pF ± 0.5% 350V	424/4/98027/118
C10	64 pF ± 0.5 pF 350V	424/4/98027/115
Inductors, r.f.		
L1	0.313 - 0.368 uH min.	406/8/11037/009
L2	0.254 - 0.286 uH min.	406/8/11037/010
L3	0.220 - 0.260 uH min.	406/8/11037/011
L4	0.151 - 0.177 uH min.	406/8/11037/012

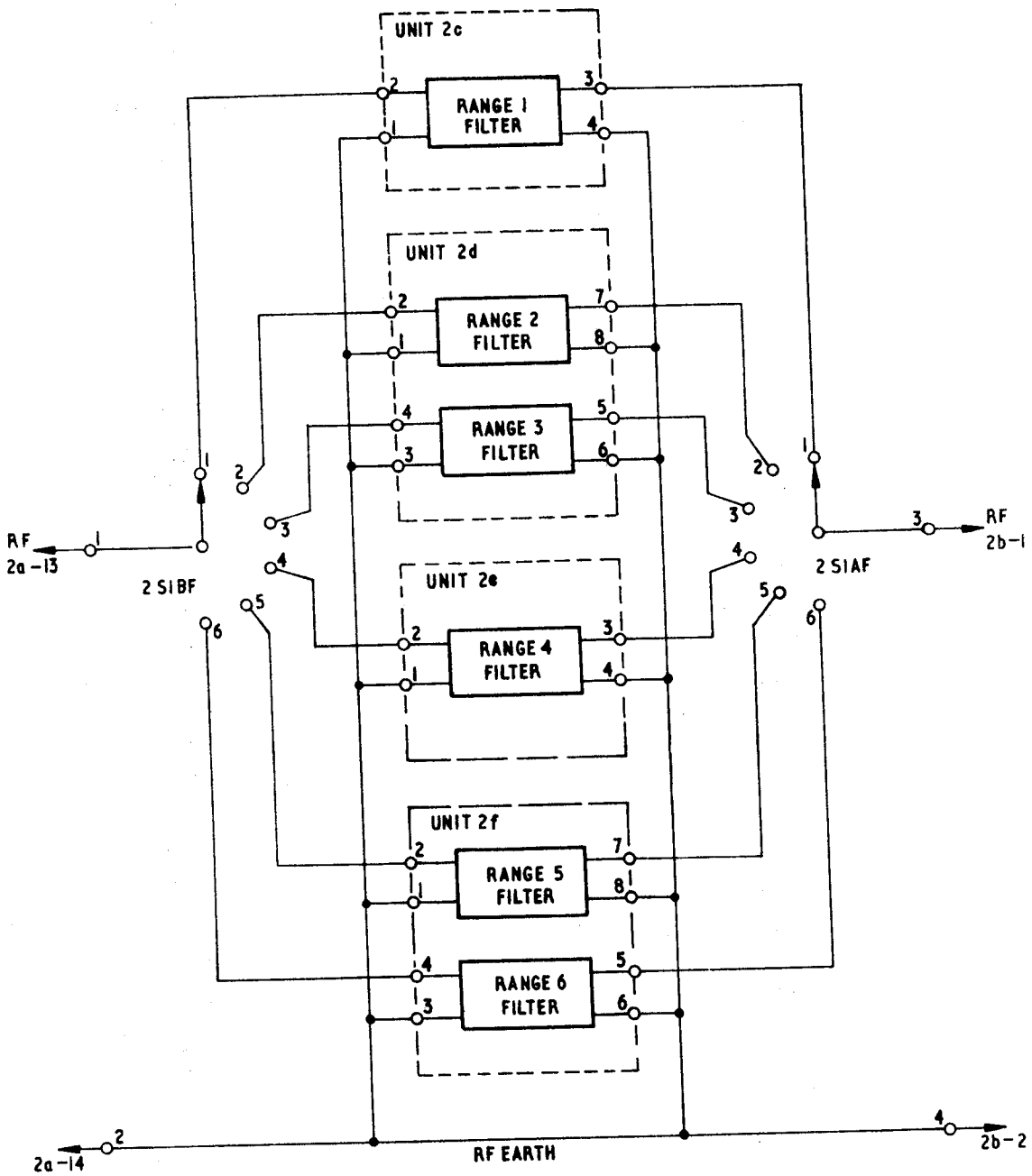
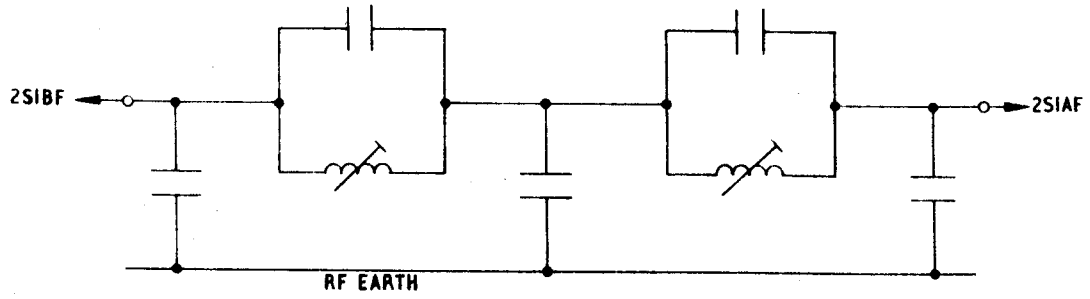


Fig. 1 PA Switch & filter - circuit diagram



RANGE	COMPONENT REFERENCES					UNIT
1	C1	C2 / L1	C3	C4 / L2	C5	2c
2	C1	C3 / L1	C5	C7 / L3	C9	2d
3	C2	C4 / L2	C6	C8 / L4	C10	2d
4	C1	C2 / L1	C3	C4 / L2	C5	2e
5	C1	C3 / L1	C5	C7 / L3	C9	2f
6	C2	C4 / L2	C6	C8 / L3	C10	2e

FOR COMPONENT VALUES REFER TO COMPONENT LISTS

Fig. 2 PA Filter – circuit diagram

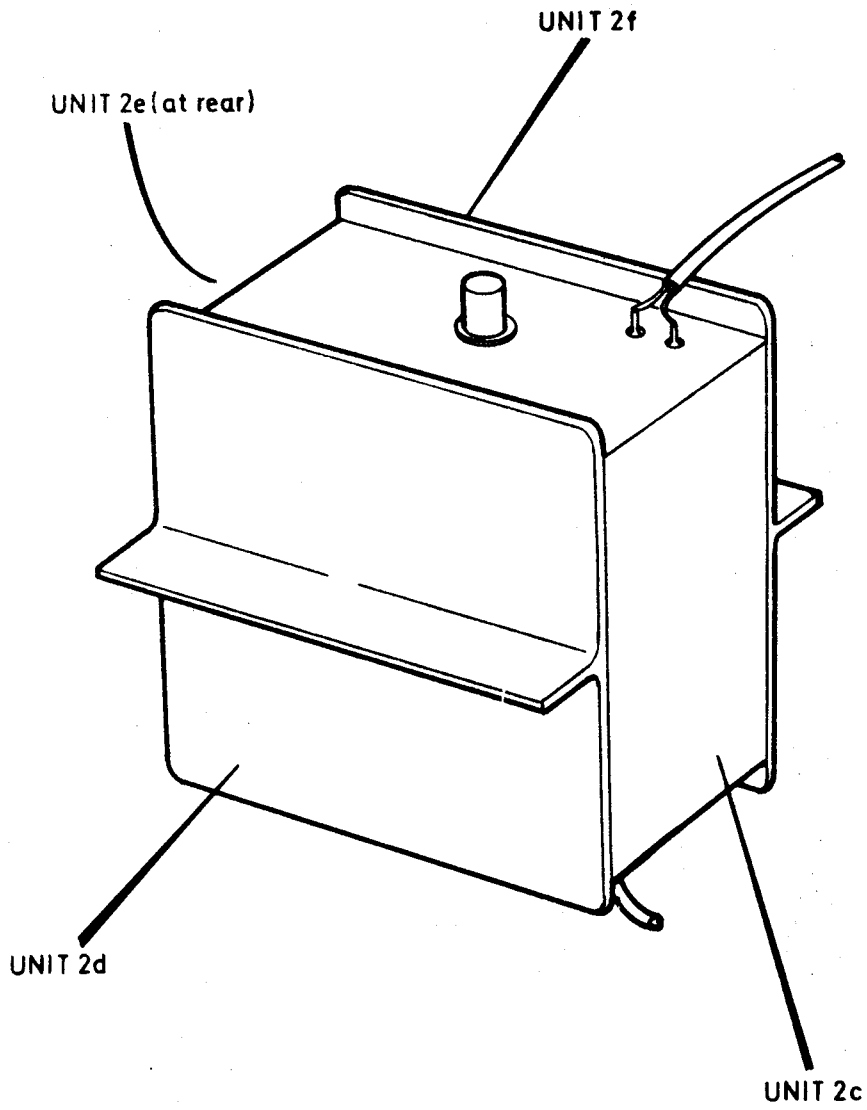
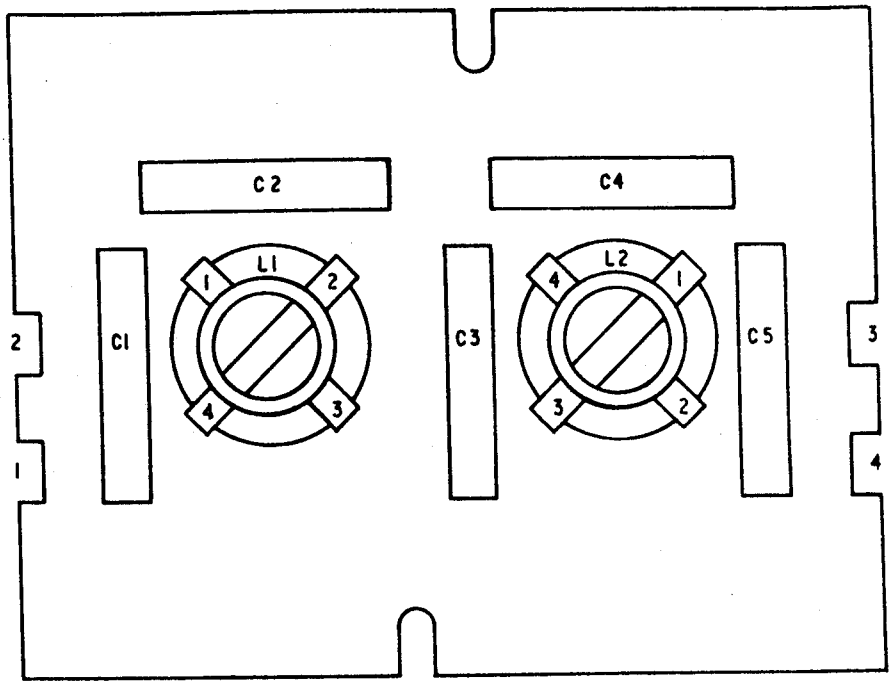
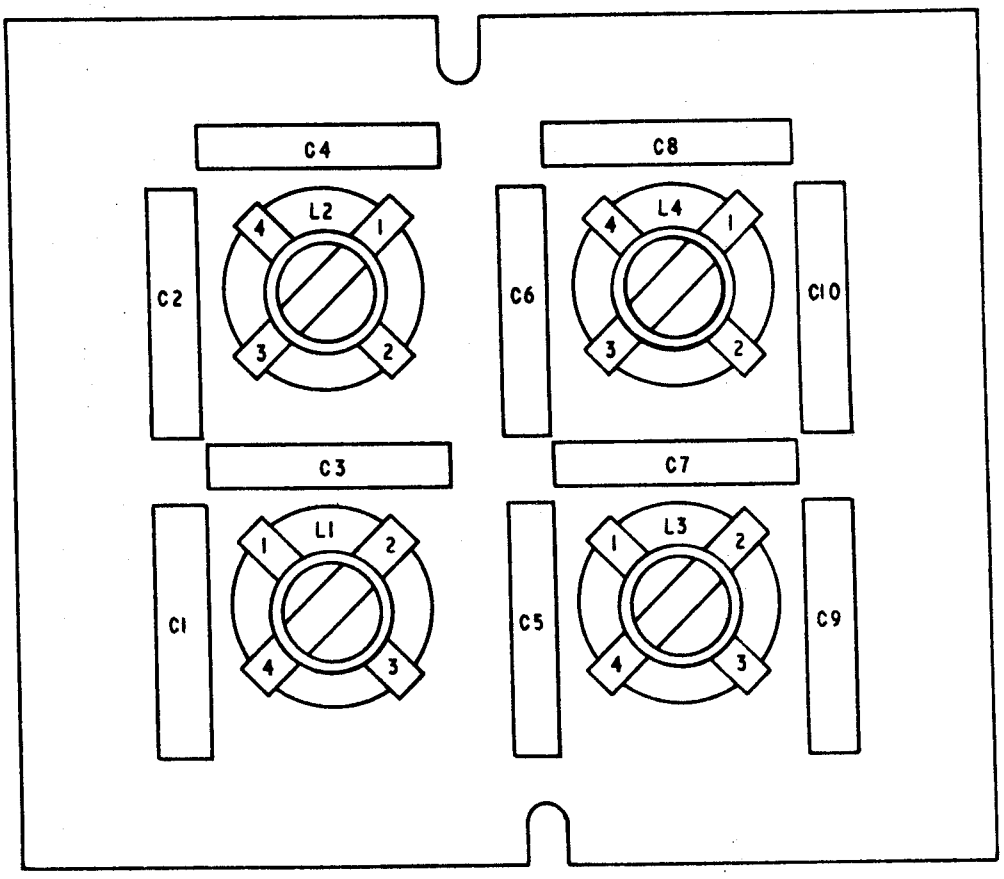


Fig. 3 Scrap view showing location of principal components



UNIT 2c OR 2e



UNIT 2d OR 2f

Fig.4 Units 2c – 2f component layout

THIRD LINE SERVICING

OF

RF DECOUPLING UNIT 419/1/11855

(Unit 2g)

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DESCRIPTION

1. The RF Decoupling Unit (Unit 2g) is a component part of the transmitter-receiver and is normally located on the Rear Panel Assembly (Unit 2). It consists of a panel, electronic circuit (pec), two 7-way audio sockets (2SK5, 2SK6) which are connected to the pec by flexible connectors, and a 9-way plug (2PL3) which is connected to the pec by flying leads.

2. The unit provides decoupling of spurious RF signals from the microphone, earphone and pressel lines. It also provides two thermistors which protect the 24V dc supply from the radio to external equipment by limiting the current drain to less than 200 mA when the supply outlet is shorted to ground.

3. A circuit diagram of the unit is given in Fig.1.

TESTING

4. Before Unit 2g can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

COMPONENTS LIST

5. The principal component parts of Unit 2g are listed on the following page and the component layout is given in Fig.2.

Cct.Ref.	Description	Reference No.
Resistors		
R1,2	Thermistors P.T.C.	403/9/03552
R3	Fixed film 1 ohm ± 10% 0.5W	403/4/03540/001
Capacitors		
C1	22 uF ± 10% 35V electrolytic	402/4/56322/220
C2,3	10 nF ± 20% 100V	400/4/20544/100
C4 to 6,C9	68 nF ± 20% 50V	400/4/20544/680
C7,8	4.7 uF ± 10% electrolytic 35V	402/4/56321/470
Inductors		
L1,2	Inductor 18 uH	406/9/08470/027
Miscellaneous		
2PL3	Plug, electrical, 9-way	508/4/21513/001
2SK5,6	Socket, electrical, fixed	508/9/20411/003
	Insulator	640/2/09855
	Spacer	640/2/09858
	Saddle (for securing R1, R2)	640/2/14912
	Panel, printed circuit flexible to 2SK5	419/1/11908
	Panel, printed circuit flexible to 2SK6	419/1/11923
	Bracket (adjacent to L1)	640/2/09853
	Bracket assembly (adjacent to C1)	640/2/09584
	Screw, slotted pan hd., M2.5 x 10 mm. st.st.	991/4/01737/006
	Washer, crinkle M2.5	991/4/10604/003
	Nut, hex., M2.5 st.st.	991/4/01495/003

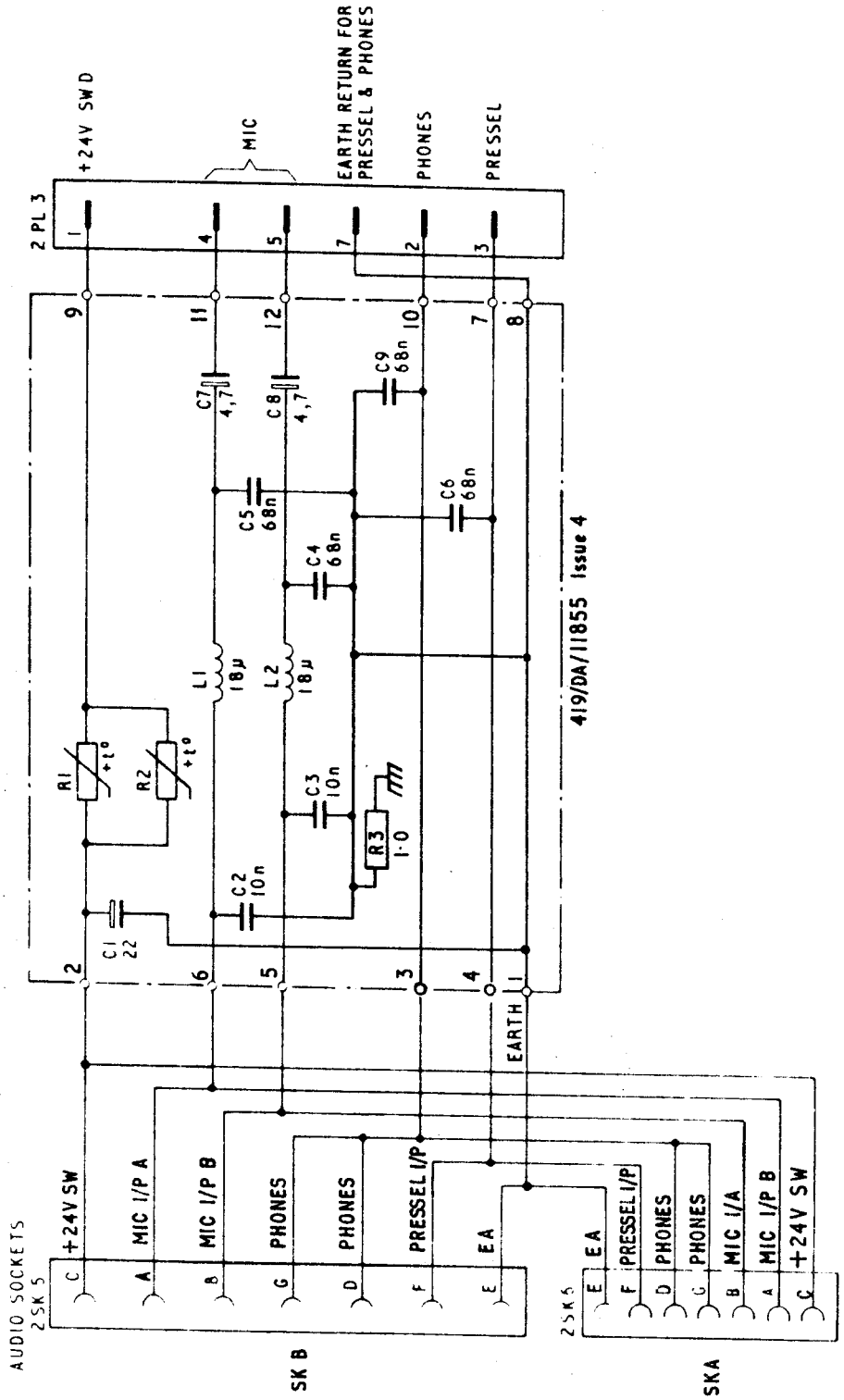

Fig. 1 Unit 2g RF decoupler - circuit

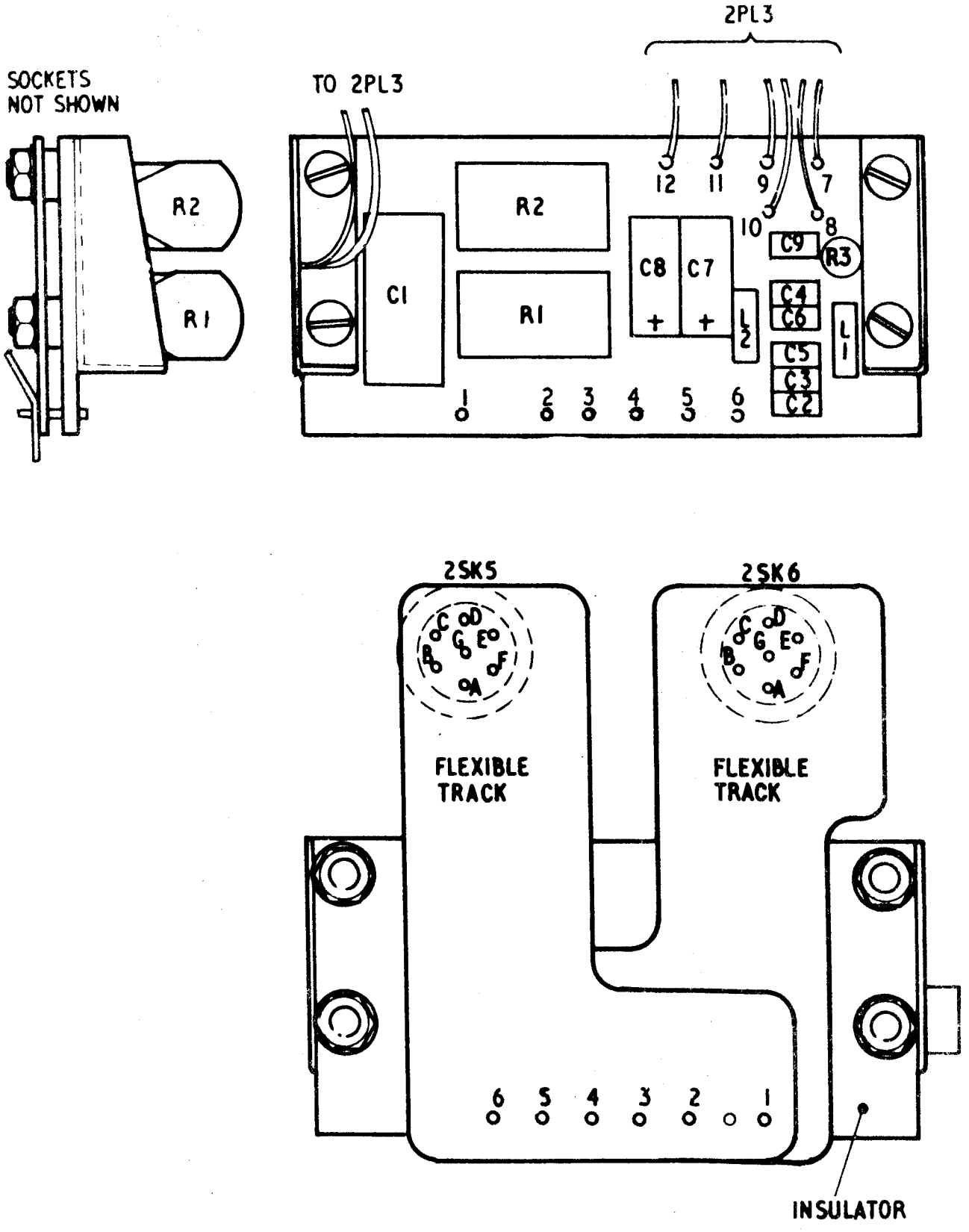

Fig.2 RF decoupler pec (unit 2g) — component layout

THIRD LINE SERVICING

OF

VHF FILTER 640/1/09648

(Unit 2h)

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ILLUSTRATIONS

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INTRODUCTION

1. The VHF Filter Assembly (Unit 2h) is a component part of the transmitter-receiver and is normally located on the Rear Panel Assembly (Unit 2). It consists of a screening can and a panel electronic circuit. Two coaxial flying leads connect the unit to the associated external circuits.

2. The unit is a low pass filter which reduces the level of broadband noise and spurious outputs at frequencies above 33 MHz by at least 25 dB.

DETAILED DESCRIPTION

3. The filter (refer to Fig.1) consists of a three-section, low pass, Darlington-type filter comprising ten fixed capacitors and three variable inductors.

4. The filter has the following characteristics:

Pass-band	2 - 30 MHz
Pass-band ripple	less than 1 dB
Stop-band edge	32.8 MHz
Stop-band rejection	greater than 25 dB

TESTING

5. Before Unit 2h can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

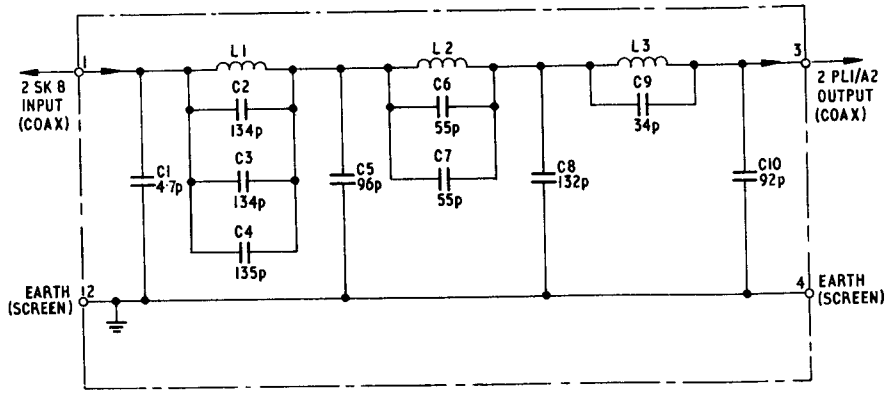
COMPONENTS LIST

6. The principal component parts of the VHF Filter Assembly 640/1/09648 are:

Panel, electronic circuit	419/1/11825
Screen can assembly	640/1/09620

7. The component parts of the Panel, Electronic Circuit 419/1/11825 (refer to Fig.1) are:

Cct.Ref.	Description	Reference No.
Capacitors, silver mica		
C1	4.7 pF ± 0.25 pF 10V	400/9/19080/004
C2,3	134 pF ± 0.5% 350V	438/9/30100/111
C4	135 pF ± 0.5% 350V	438/9/30100/112
C5	96 pF ± 0.5 pF 350V	438/9/30100/109
C6,7	55 pF ± 0.5 pF 350V	438/9/30100/107
C8	132 pF ± 0.5% 350V	438/9/30100/110
C9	34 pF ± 0.5 pF 350V	438/9/30100/106
C10	92 pF ± 0.5 pF 350V	438/9/30100/108
Inductors, r.f.		
L1	0.056 to 0.060 uH min.	406/8/11037/013
L2	0.190 to 0.220 uH min.	406/8/11038
L3	0.27 to 0.29 uH min.	406/8/11037/014



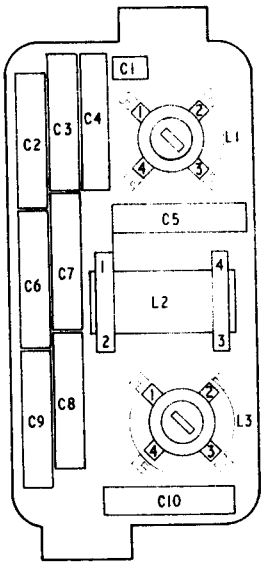


Fig. 1 VHF Filter (unit 2h) – circuit diagram and pec component layout

THIRD LINE SERVICING

OF

TURRET ASSEMBLY 640/1/09591

(Unit 3)

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4	Double Tuned Circuit Static Block (Unit 3a)	21
5	Turret Coils, RF Tuning	23
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7	Turret Coils, Oscillator	27

INTRODUCTION

1. The Turret Assembly (Unit 3) is a component part of the transmitter-receiver and is normally located on the Front Panel and Chassis Assembly (Unit 1). It provides the following:

(1) A variable frequency oscillator (VFO)

(2) The receiver RF amplifier (single tuned input circuit).

(3) The receiver RF/IF mixer.

(4) A receiver IF stage.

(5) A double tuned filter.

2. Coarse tuning (i.e. frequency range) for items (1), (2) and (5) is selected by a six position switch and, within each range, fine tuning is provided by varactor diodes which respond to a control voltage from a frequency synthesiser (Unit 9).

3. The double tuned filter is employed in either the transmit path or the receive path, selection being made by a relay.

DESCRIPTION

4. The turret is a six position manually controlled switch. Each position utilises a different pair of plug-in panels, electronic circuit (pec), which rotate with the switch mechanism. A small plate on the turret casting covers a port that gives access to whichever pair of pec has been selected.

5. Six of the pec (Units 3b-3g inc.) provide the single/double circuit tuning for ranges 1 to 6 respectively, the other six pec (Units 3j-3p inc.) provide the VFO tuning for ranges 1 to 6 respectively.

6. Two other pec (Units 3a and 3h) are mounted in the turret casting, beneath a large cover plate. Unit 3h contains the VFO circuits and Unit 3a contains the remainder of the RF circuits listed in para.1.

DETAILED DESCRIPTION

RF Circuits (see Fig.1)

7. The RF signal applied to pin 11 is fed to a single tuned circuit selected by the range switch and then to ML2. The integrated circuit ML2 is a variable gain broadband RF amplifier controlled by the receiver AGC voltage fed to pin 9 of Unit 3a.

8. When relay RL1/2 is not operated, its contacts connect ML2 output to ML1 via the double tuned circuit selected by the range switch.

9. Both the single and double tuned circuits are tuned by varactor diodes controlled by a dc voltage supplied to pin 12 of Unit 3a. The control voltage is in the range 5 to 80V and is used to set the centre of the response curve of the tuned circuits at the frequency of operation.

10. The integrated circuit ML1 is a double balanced modulator. The output at ML1 pin 5 is a complex waveform containing the sum and difference frequencies of the inputs to ML1 pins 7 and 3 (RF from ML2 and RF from the VFO), the original frequencies are effectively suppressed. Ignoring any audio component in the receiver RF signal, the difference between the two frequencies is normally 1.75 MHz. The circuit L2/C4/C5 is tuned to 1.75 MHz and has a bandwidth covering the upper and lower sideband components (i.e. audio components). Thus, the difference frequency is selected and is amplified by TR1/TR2 before being passed to the Rx IF output at pin 7 of Unit 3a.

11. Relay RL1/2 is operated when +24V is applied to pin 1 of Unit 3a; its contacts disconnect the double tuned circuit from the receiver RF path and connect the circuit in the transmitter RF path (between pins 13 and 12 of Unit 3a).

VFO (see Fig.2)

12. ML1 on Unit 3h is an oscillator, the frequency of which is determined by the tuned circuit connected between pins 2 and 10 of ML1. This tuned circuit is selected by the range switch and is tuned by varactor diodes controlled by a dc voltage in the range 5 to 80V supplied to pin 8 of Unit 3h. (In practice, this and the similar input to Unit 3a, are connected to a common source, the synthesiser).

13. ML1 provides three sine-wave outputs, two of these outputs are used to supply the transmitter and receiver modulators respectively and are between

200 and 400 mV peak-to-peak. The third output is between 1000 and 1700 mV peak-to-peak and is used to supply the synthesiser control loop.

TESTING

14. Before Unit 3 can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

FAULT FINDING

15. The information given in Tables 1 to 3 is intended to aid diagnosis of the location of a fault; it provides the nominal voltage levels between designated points, related to specific test conditions as obtained with the relevant test configuration in Part 4.

NOTE: If Unit 3 is still fitted to Unit 1, the test conditions AGC and 24V switched off, as stipulated in Tables 1 and 2, can be obtained by removing link at TPf in Unit 6 (AGC off) and by leaving the unit in receive mode (24V off). In both cases, the required RF input should be applied to the antenna socket or to 1SK1/A1 as appropriate.

COMPONENTS LIST

16. For details of the component parts of Unit 3, refer to para.17. For detailed breakdown of these parts, refer to paras.18 to 31.

Table 1

Unit 3a - Typical d.c. voltages

With AGC and 24V switches off, no RF input and measuring w.r.t. Unit 3a pin 4 (earth).

ML1 pin	Measure at	Volts
2	C8	2.5
3	Pin 5	2.8
4	Pin 8	6.0
5	L2/2	6.0
7	C9	2.8

ML2 pin	Measure at	Volts
2	Pin 8	6.0
3	R11	1.7
5,6	C13	0.9
7	Pin 9	0
-	TR1b/R2	1.3
-	TR1c/R1	3.0
-	TR2b/R4	0.65

Table 2

Unit 3a - Typical r.f./i.f. voltages

With 1 mV r.f. input, AGC and 24V switches off and measuring w.r.t. Unit 3a pin 4 (earth).

Measure at	r.f./i.f. (mV)
Contact B	1.2
R11 (ML2/3)	1.2
TPb	2.4
TPc	2.8
T1/2	3.0
TPe	30

Table 3

Unit 3h - Typical r.f. test voltages

R.F. present at all times and measured w.r.t. Unit 3h pin 3 (earth).

Measure at	r.f. (mV)
TPp	1600 pp
Pin 4	300 pp
Pin 2	300 pp

17. The principal component parts of Unit 3, 640/1/09591 are listed below and the component layout is given on Fig.3.

Unit	Description	Reference No.
	Filter, low pass	422/9/07510
	Screen	640/2/09664
	Housing and rotor assembly, consists of:-	640/1/09661
	Housing assembly	640/1/09762
	Rotor, D.T.C.T. assembly, including:-	640/1/09765
	Cheek assembly (right hand)	640/1/09860
	Cheek assembly (left hand)	640/1/09861
	Clip retaining	640/2/09862
	Screen	640/2/09684
	Rotor, oscillator assembly, including:-	640/1/09764
	Cheek assembly (right hand)	640/1/09860
	Cheek assembly (left hand)	640/1/09861
	Clip retaining	640/2/09862
	Back plate assembly	640/1/09766
	End plate, front assembly	640/1/09767
	Coupling assembly	640/1/09768
	Shaft assembly	640/1/09856
	Spring	640/1/14902
	Spring	640/1/14904
	Ring, retaining clip, external 4.8 mm	999/4/01303/003
	Circlip, external 6 mm. shaft	999/4/00451/008
3a	Double tuned circuit static block p.e.c.	419/1/11860
3b	R.F. tuning coil, range 1	406/8/11102/001
3c	R.F. tuning coil, range 2	406/8/11102/002
3d	R.F. tuning coil, range 3	406/8/11102/003
3e	R.F. tuning coil, range 4	406/8/11102/004
3f	R.F. tuning coil, range 5	406/8/11102/005
3g	R.F. tuning coil, range 6	406/8/11102/006
3h	Oscillator static block p.e.c.	419/1/11960
3j	Oscillator coil, range 1	406/8/11101/001
3k	Oscillator coil, range 2	406/8/11101/002
3l	Oscillator coil, range 3	406/8/11101/003
3m	Oscillator coil, range 4	406/8/11101/004
3n	Oscillator coil, range 5	406/8/11101/005
3p	Oscillator coil, range 6	406/8/11101/006

18. The principal component parts of Unit 3a, 419/1/11860 are listed below and the component layout is given on Fig.4.

Cct.Ref.	Description	Reference No.
Resistors		
R1	620 ohm ± 2% 0.25W	403/4/05522/620
R2	10k ohm ± 2% 0.25W	403/4/05524/100
R3	150 ohm ± 2% 0.25W	403/4/05522/150
R4	1.2k ohm ± 2% 0.25W	403/4/05523/120
R5	200 ohm ± 2% 0.25W	403/4/05522/200
R6	75 ohm ± 2% 0.25W	403/4/05521/750
R7	10k ohm ± 2% 0.25W	403/4/05524/100
R8	100 ohm ± 2% 0.25W	403/4/05522/100
R9,10	100k ohm ± 2% 0.25W	403/4/05525/100
R11	75 ohm ± 2% 0.25W	403/4/05521/750
R12	1k ohm ± 2% 0.25W	403/4/05523/100
R13	100k ohm ± 2% 0.25W	403/4/05525/100
Capacitors		
C1,2	68 nF ± 20% 50V	400/4/20544/680
C3	10 nF ± 20% 100V	400/4/20544/100
C4	100 pF ± 5% 100V	400/9/20437
C5	300 pF ± 1% 350V, silver mica	424/4/98027/105
C6	10 nF ± 20% 100V	400/4/20544/100
C7	6.8 uF ± 10% 6V, electrolytic	402/4/55721/680
C8	68 nF ± 20% 50V	400/4/20544/680
C9	10 nF ± 20% 100V	400/4/20544/100
C10	68 nF ± 20% 50V	400/4/20544/680
C11	10 nF ± 20% 100V	400/4/20544/100
C12	6.8 uF ± 10% 6V, electrolytic	402/4/55721/680
C13	10 nF ± 20% 100V	400/4/20544/100
Inductors		
L1	Inductor 18 uH ± 10%	406/9/08470/027
L2	Inductor	406/8/11030/002
Semi-conductor devices		
TR1,2	Transistor C648 (BSY95A)	417/4/98681
D1 to 4	Diode, varactor, DB 4299	415/4/05441
D5,6	Diode C756	415/4/98869
D7,8	Diode, varactor, DB 4299	415/4/05441
ML1	Integrated circuit CN 615T	446/4/00427
ML2	Integrated circuit CN 599T	446/4/00421
Miscellaneous		
RL1	Relay	507/9/05095
	Contact block assembly	640/1/09668
	Screw, ch.hd. slotted M2 x 5 mm st.st.	991/4/02030/054

19. The principal component parts of Unit 3b, 406/8/11102/001 are listed below and the component layout is given on Fig.5a.

Cct.Ref.	Description	Reference No.
Capacitors		
C1 to 3	5.5 to 18 pF variable	401/9/32185
C4	1.6 pF ± 0.1 pF 500V	400/9/18825/004
C5	10 nF ± 10% 100V	400/9/19083/051
Miscellaneous		
	Contact block	640/2/09670
	Spring	640/2/09778
Inductors		
L1	Printed spiral coil	419/2/11876
L2,3	Printed spiral coil	419/2/11871

20. The principal component parts of Unit 3c, 406/8/11102/002 are listed below and the componenty layout is given on Fig.5a.

Cct.Ref.	Description	Reference No.
Capacitors		
C1 to 3	5.5 to 18 pF variable	401/9/32185
C4	1.8 pF ± 0.1 pF 500V	400/9/18825/005
C5	10 nF ± 10% 100V	400/9/19083/051
Miscellaneous		
	Contact block	640/2/09670
	Spring	640/2/09778
Inductors		
L1	Printed spiral coil	419/2/11891
L2,3	Printed spiral coil	419/2/11886

21. The principal component parts of Unit 3d, 406/8/11102/003 are listed below and the component layout is given on Fig.5a.

Cct.Ref.	Description	Reference No.
Capacitors		
C1 to 3	5.5 to 18 pF variable	401/9/32185
C4	1.0 pF ± 0.1 pF 500V	400/9/18825/001
C5	10 nF ± 10% 100V	400/9/19083/051
Miscellaneous		
	Contact block	640/2/09670
	Spring	640/2/09778
Inductors		
L1	Printed spiral coil	419/2/11906
L2,3	Printed spiral coil	419/2/11901

22. The principal component parts of Unit 3e, 406/8/11102/004 are listed below and the component layout is given on Fig.5a.

Cct.Ref.	Description	Reference No.
Capacitors		
C1 to 3	5.5 to 18 pF variable	401/9/32185
C4	2.0 pF ± 0.1 pF 500V	400/9/18825/006
C5	10 nF ± 10% 100V	400/9/19083/051
Miscellaneous		
	Contact block	640/2/09670
	Spring	640/2/09778
Inductors		
L1	Printed spiral coil	419/2/11921
L2,3	Printed spiral coil	419/2/11916

23. The principal component parts of Unit 3f, 406/8/11102/005 are listed below and the component layout is given on Fig.5b.

Cct.Ref.	Description	Reference No.
Resistors		
R1	10k ohm ± 5%	403/9/03547
Capacitors		
C1 to 3	5.5 to 18 pF variable	401/9/32185
C4	2.0 pF ± 0.1 pF 500V	400/9/18825/006
C5	6.8 nF ± 10% 100V	400/9/19083/047
Miscellaneous		
	Contact block	640/2/09670
	Spring	640/2/09778
Inductors		
L1 to 3	Printed spiral coil	

24. The principal component parts of Unit 3g, 406/8/11102/006 are listed below and the component layout is given on Fig.5c.

Cct.Ref.	Description	Reference No.
Resistors		
R1	10k ohm ± 5%	403/9/03547/001
Capacitors		
C1 to 3	5.5 to 18 pF variable	401/9/32185
Inductors		
L1 to 3	Printed spiral coils	
L4	Inductor	406/8/11108/001
Miscellaneous		
	Contact block	640/2/09670
	Spring	640/2/09778

25. The principal component parts of Unit 3h, 419/1/11960 are listed below and the component layout is given on Fig.6.

Cct.Ref.	Description	Reference No.
Resistors		
R1,2	47k ohm ± 2% 0.25W	403/4/05524/470
R3,4	39k ohm ± 2% 0.25W	403/4/05524/390
Capacitors		
C1,2	10 nF ± 20% 100V	400/4/20544/100
C3	470 nF ± 20% 50V	400/4/20495/470
C4	3 pF ± 0.25 pF 500V	400/9/18825/009
C5,6	10 nF ± 20% 100V	400/4/20544/100
C7	10 nF ± 20% 100V	400/4/20564/100
C8 to 10	10 nF ± 20% 100V	400/4/20544/100
C11,12	100 nF ± 10% 100V	400/4/19495/100
C13	68 nF ± 20% 50V	400/4/20544/680
C14,15	100 nF ± 10% 100V	400/4/19495/100
C16	68 nF ± 20% 50V	400/4/20544/680
Semi-conductor devices		
D1,2	Diode, varactor DB 4299	415/4/05441
D3	Diode, BAX-16	415/4/05449
ML1	Integrated circuit CN597T	446/4/00420
Miscellaneous		
	Block assembly, oscillator	640/1/09761
	Earth connection	640/1/09672
	Screw, ch.hd., slotted, M2 x 5 mm st.st.	991/4/02030/054

26. The principal component parts of Unit 3j, 406/8/11101/001 are listed below and the component layout is given on Fig.7a.

Cct.Ref.	Description	Reference No.
Capacitors		
C1	5.5 to 18 pF variable	401/9/32185
C2	200 pF ± 10% 350V, silver mica	438/9/30100/083
C3	10 pF ± 5% 100V	400/9/19080/075
Inductors		
L1	Printed spiral coil	419/2/11971
L2	Inductor 100 uH	406/9/08490/033
Miscellaneous		
	Spring	640/2/09778
	Contact block	640/2/09673

27. The principal component parts of Unit 3k, 406/8/11101/002 are listed below and the component layout is given on Fig.7a.

Cct.Ref.	Description	Reference No.
Capacitors		
C1	5.5 to 18 pF variable	401/9/32185
C2	308 pF ± 1% 350V, silver mica	438/9/30100/099
C3	10 pF ± 5% 100V	400/9/19080/075
Inductors		
L1	Printed spiral coil	419/2/11981
L2	Inductor 47 uH	406/9/08490/029
Miscellaneous		
	Spring	640/2/09778
	Contact block	640/2/09673

28. The principal component parts of Unit 31, 406/8/11101/003 are listed below and the component layout is given on Fig.7a.

Cct.Ref.	Description	Reference No.
Capacitors		
C1	5.5 to 18 pF variable	401/9/32185
C2	470 pF ± 1% 350V, silver mica	438/9/30100/055
C3	6.8 pF ± 5% 100V	400/9/19080/072
Inductors		
L1	Printed spiral coil	419/2/11991
L2	Inductor 33 uH	406/9/08390/027
Miscellaneous		
	Spring	640/2/09778
	Contact block	640/2/09673

29. The principal component parts of Unit 3m, 406/8/11101/004 are listed below and the component layout is given on Fig.7a.

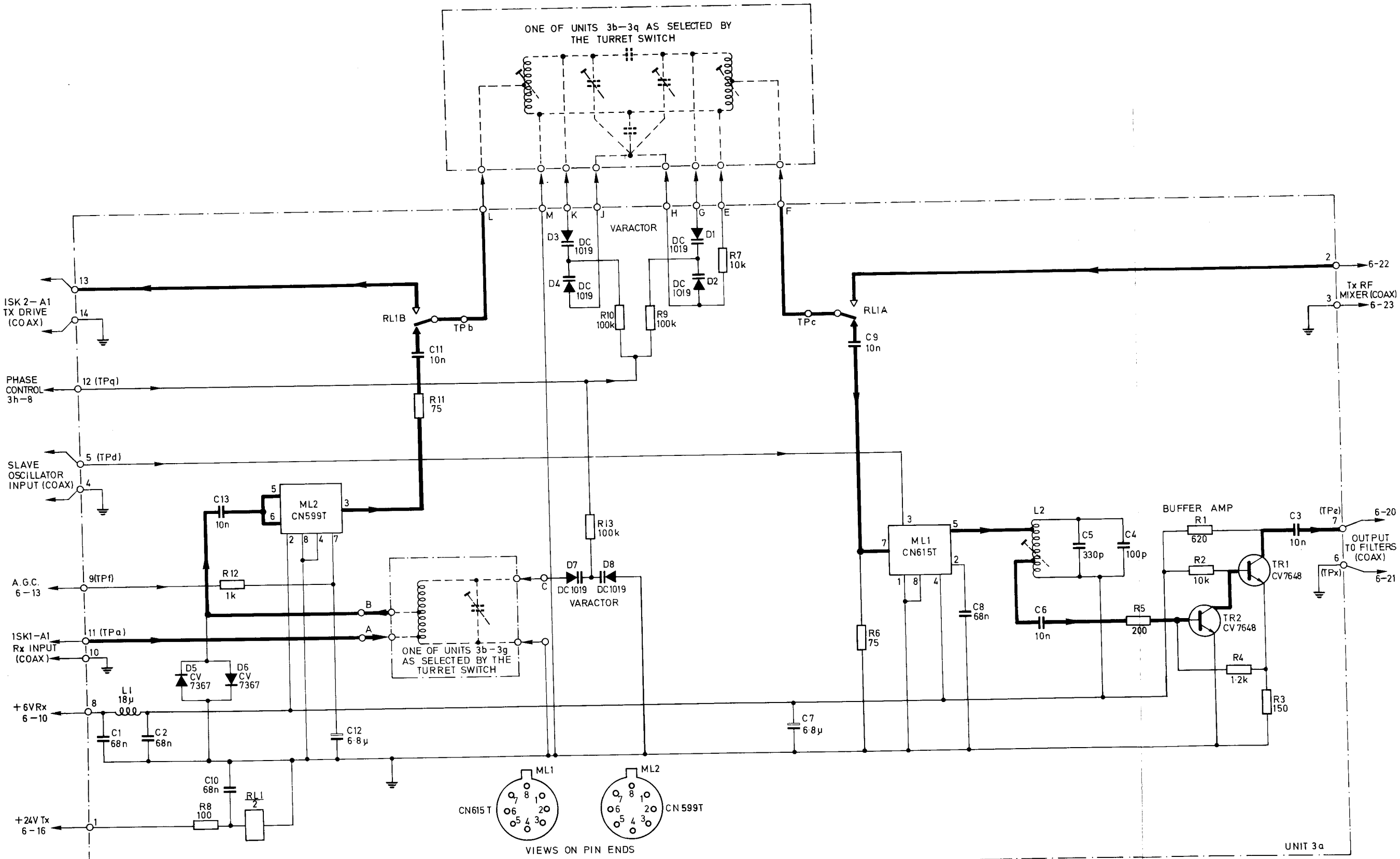
Cct.Ref.	Description	Reference No.
Capacitors		
C1	5.5 to 18 pF variable	401/9/32185
C2	732 pF ± 1% 350V, silver mica	438/9/30100/098
C3	6.8 pF ± 5% 100V	400/9/19080/072
Inductors		
L1	Printed spiral coil	419/1/12001
L2	Inductor 12 uH	406/9/08470/025
Miscellaneous		
	Spring	640/2/09778
	Contact block	640/2/09673

30. The principal component parts of Unit 3n, 406/8/11101/005 are listed below and the component layout is given on Fig.7b.

Cct.Ref.	Description	Reference No.
Capacitors		
C1	5.5 to 18 pF variable	401/9/32185
C2	1124 pF ± 1% 350V, silver mica	438/9/30100/104
C3	6.8 pF ± 5% 100V	400/9/19080/072
C4	6.8 pF ± 5% 100V	400/9/18799/102
Inductors		
L1	Printed spiral coil	419/2/12011
L2	Inductor 5.6 uH	406/9/08470/021
Miscellaneous		
	Spring	640/2/09778
	Contact block	640/2/09673

31. The principal component parts of Unit 3p, 406/8/11101/006 are listed below and the component layout is given on Fig.7c.

Cct.Ref.	Description	Reference No.
Capacitors		
C1	5.5 to 18 pF variable	401/9/32185
C2	1750 pF ± 1% 200V d.c., mica	400/9/19295/001
C3	10 pF ± 5% 100V	400/9/19080/075
C4	15 pF ± 5% 100V	400/9/19080/077
Miscellaneous		
	Spring	640/2/09778
	Contact block	640/2/09673
L1	Printed spiral coil	419/2/12021



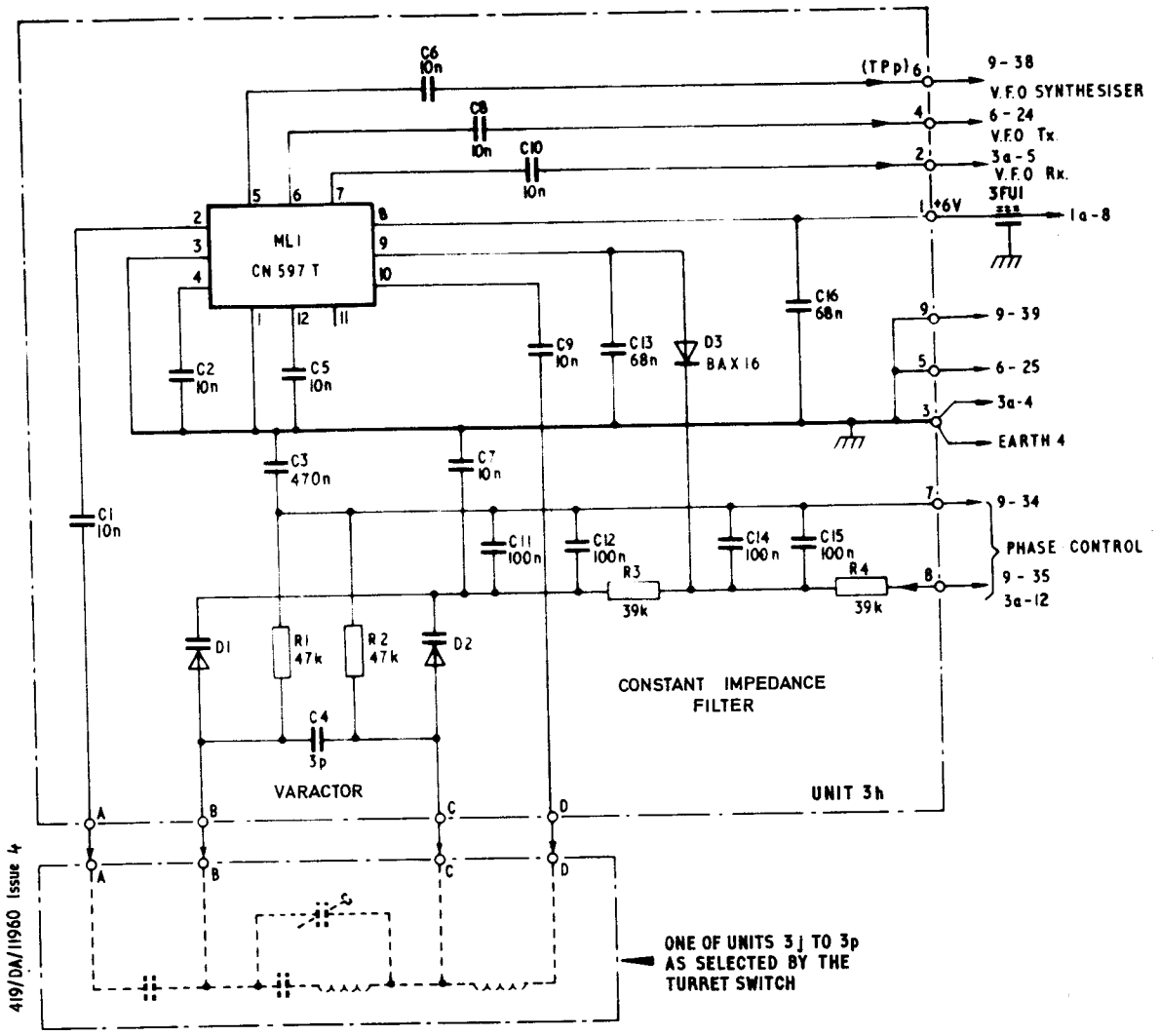
419/DA/11860 Issue 6

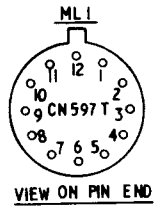
Fig.1

Issue 2

R F Circuits

Fig.1

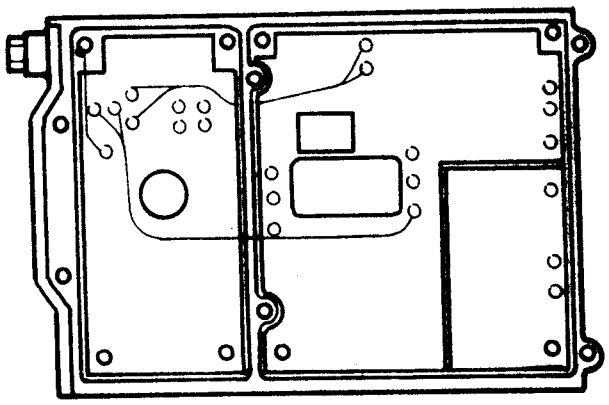




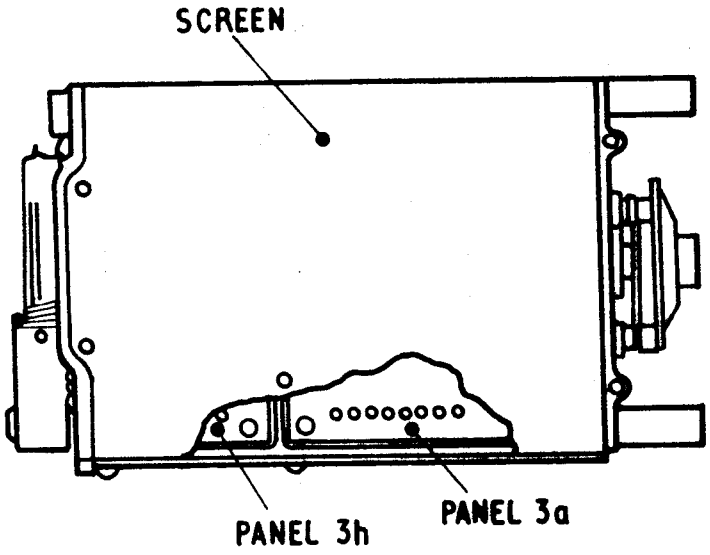
VFO – circuit

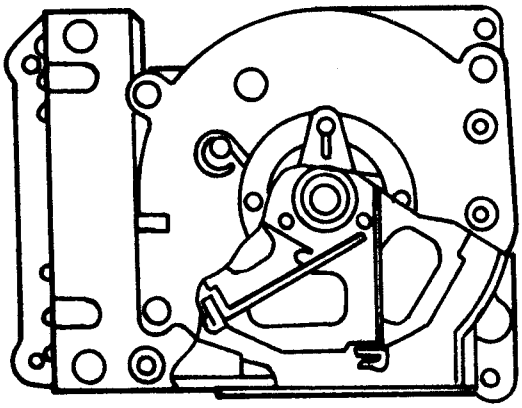
Fig. 2

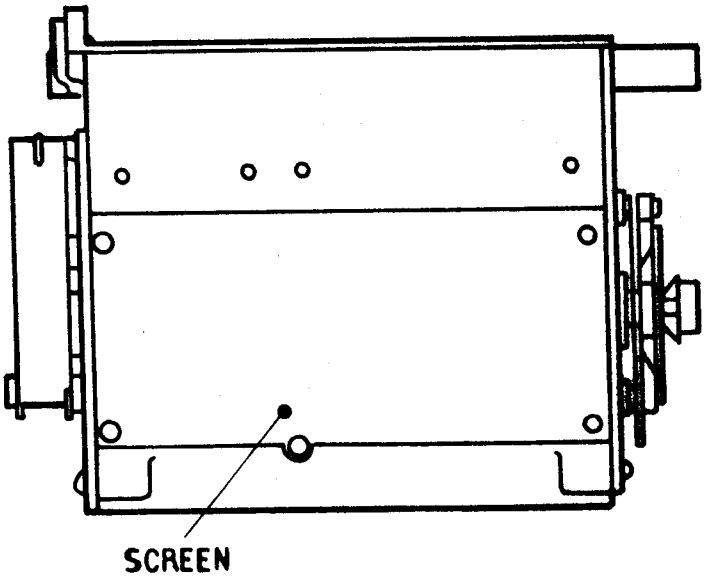
Issue 2

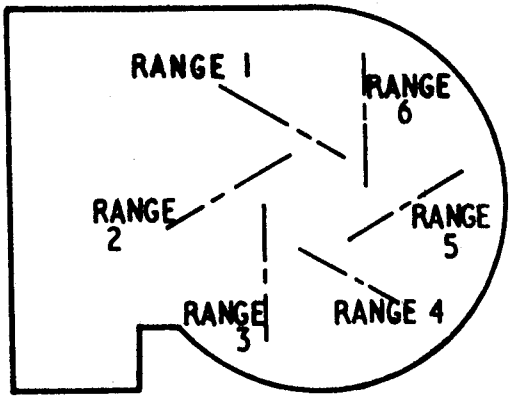


VIEW SHOWING PANEL WIRING









VIEW FROM FRONT SHOWING POSITION OF COILS

Fig.3 Turret assembly — component layout

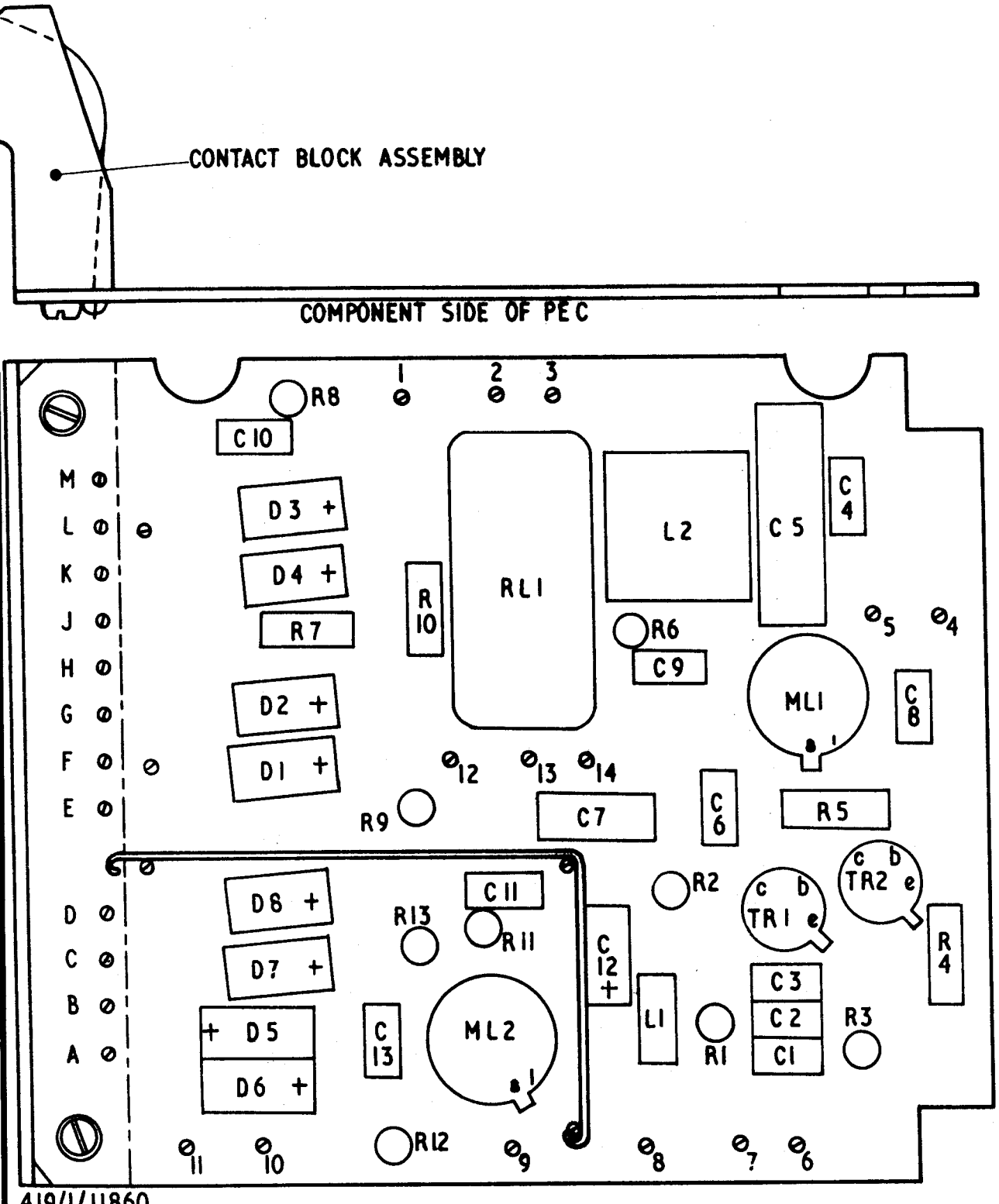


Fig. 4 Double tuned circuit static block (unit 3a)

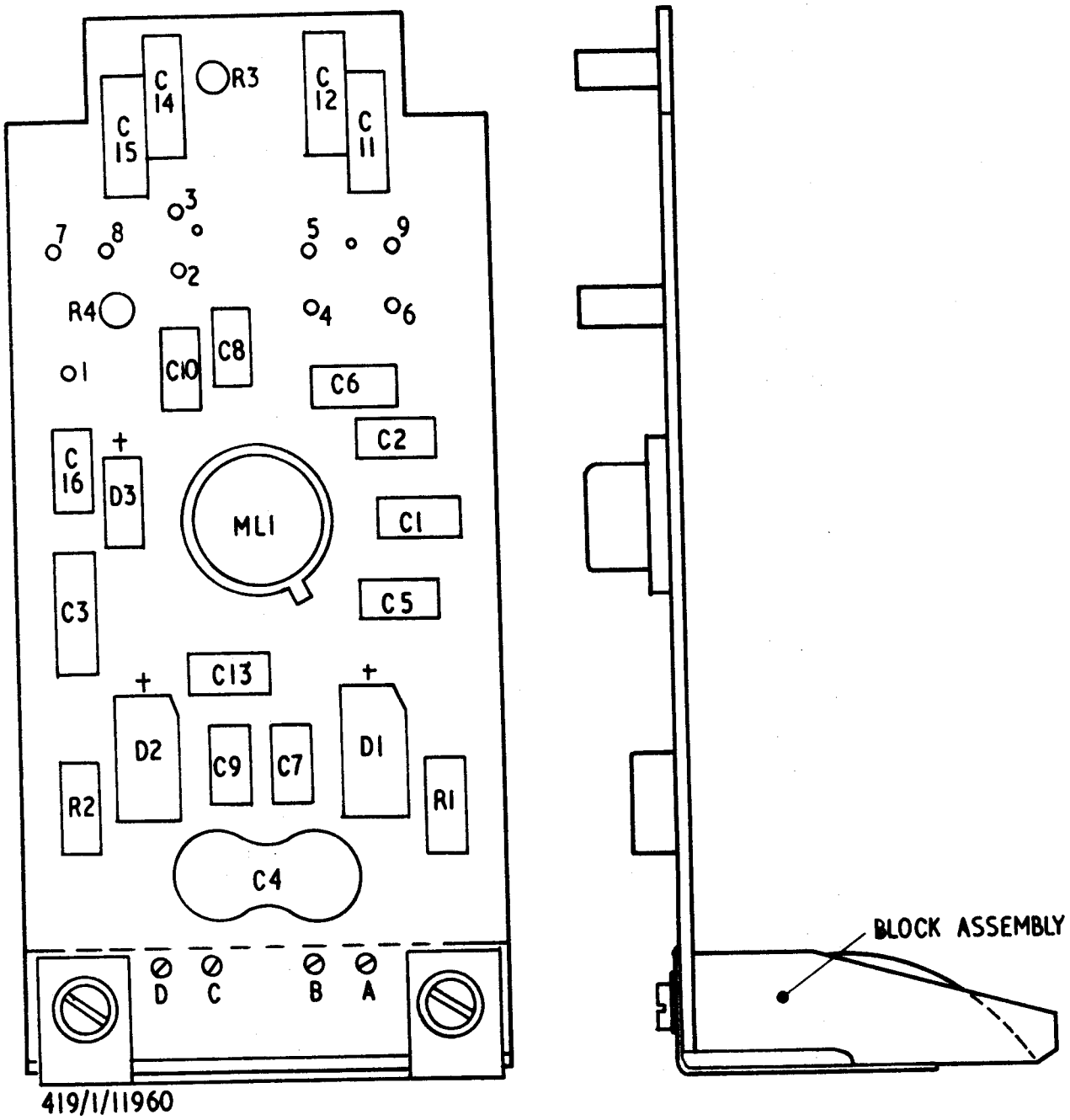


Fig.6 Oscillator static block
(unit 3h)

THIRD LINE SERVICING

OF

TUNER UNIT RF 640/1/09592

(Unit 4)

CONTENTS

	Para.
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Testing	4
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ILLUSTRATIONS

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2	ATU - assembly	5

DESCRIPTION

1. The Tuner Unit RF (Unit 4), more commonly termed Antenna Tuning Unit (ATU), is a component part of the transmitter/receiver and is normally located on the Front Panel and Chassis Assembly (Unit 1). It provides manually adjustable matching of the receiver/transmitter input/output impedance of 50 ohms into a load such as an end-fed antenna.

2. The unit consists of a 5-position switch (RANGE) selecting three variable inductors (TUNE) and capacitors, and a multi-tapped transformer with a 9-position selector switch (LOAD). A circuit diagram is given in Fig.1 and a view of the unit is given in Fig.2.

3. Connection to the antenna is via a spring loaded plunger contact at the top of the unit, connections to the transmitter/receiver sockets is by flying lead with a coaxial insert (SK1/A2).

TESTING

4. Before Unit 4 can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

COMPONENTS LIST

5. The principal component parts of Unit 4 are listed on the following page and the component layout is given in Fig.2.

Cct.Ref.	Description	Reference No.
	Drive plate assembly including:	640/1/09676
	HF core (short) (for L1,L2)	640/1/09799
	HF core (for 13)	905/9/10512
	Plate and bush assembly	640/1/09797
	Rear mounting assembly including:	640/1/09677
	Plunger contact	640/2/09806
	Spring	640/2/09807
	Front drive assembly including:	640/1/09675
L1	ATU tuning inductor coil	406/8/11035/001
L2	ATU tuning inductor coil	406/8/11035/002
L3	ATU tuning inductor coil	406/8/11035/003
Capacitors		
C1	22 pF ± 10% 750V	400/9/19076/001
C2	30 pF ± 10% 750V	
C3	33 pF ± 2% 750V	
Miscellaneous		
	Gear assembly	640/1/14819
T1+S1	ATU Loading transformer (with switch)	406/8/11032/007
S2	Switch rotary wafer	408/9/51422
	Bracket	640/2/09698

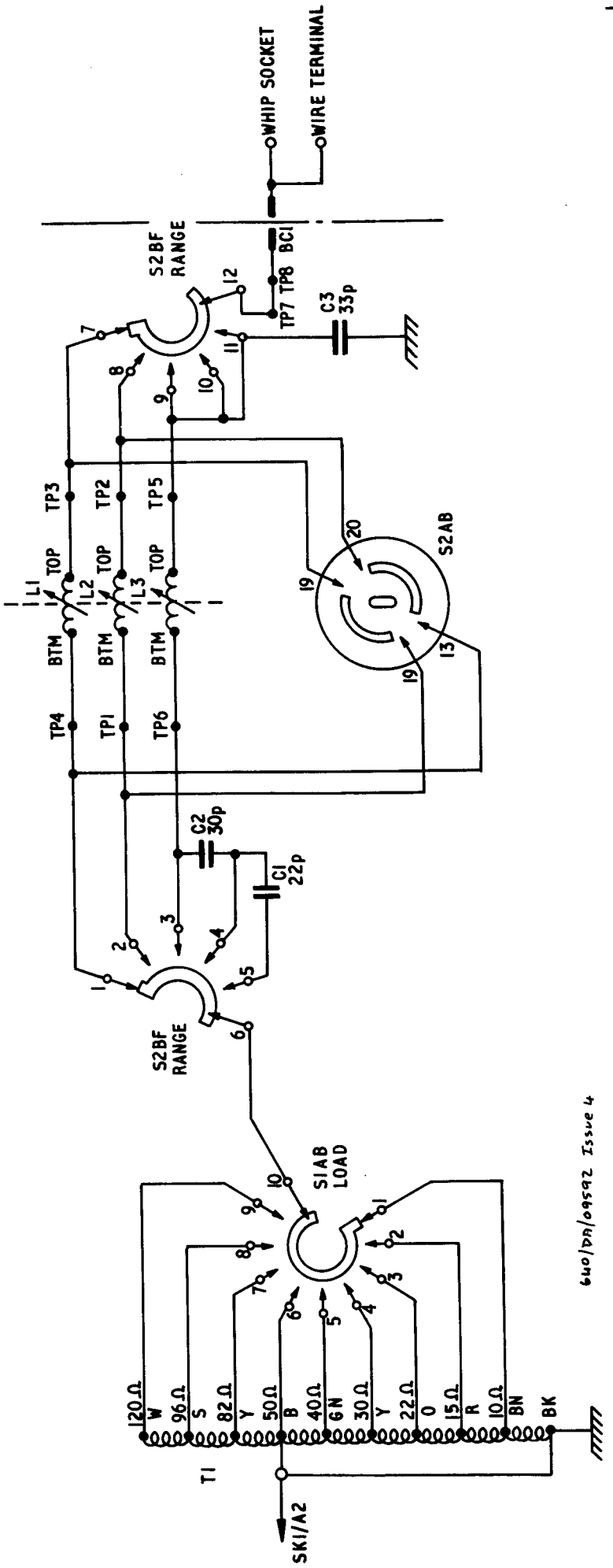

Fig. 1 ATU Circuit

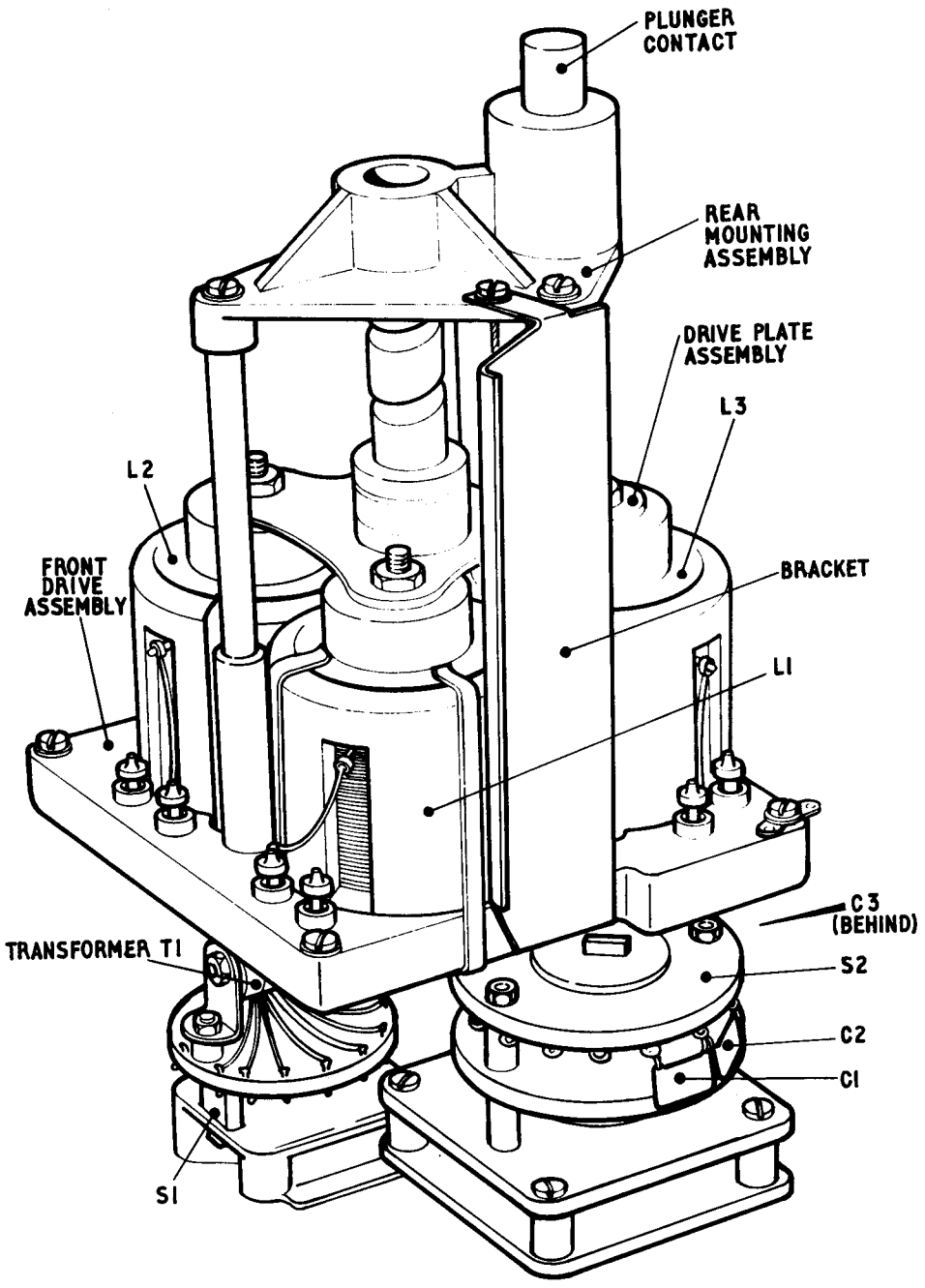

Fig. 2 ATU Assembly

THIRD LINE SERVICING

OF

POWER SUPPLY UNIT 640/1/09593

(Unit 5)

CONTENTS

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Introduction	1
Description	
General	2
+12V regulator	3
+3V regulator	7
+6V regulator	8
+110V regulator	10
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ILLUSTRATIONS

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2	Unit 5b, Power Supply +6V & +110V - circuit	9
3	Power Supply Unit Assembly (Unit 5)	11
4	Panel, Electronic Circuit (Unit 5b) - component layout	13
5	Panel, Electronic Circuit (Unit 5a) - component layout	13

INTRODUCTION

1. The Power Supply Unit (Unit 5) is a component part of the transmitter/receiver and is normally located on the Front Panel and Chassis Assembly (Unit 1). It provides five regulated dc outputs with nominal values of +3V, +6V, +6V compensated (for VFO), +12V, and +110V all derived from a nominal supply of 24V dc (limits 20 to 32V).

DESCRIPTION

General

2. The unit consists of an assembly of pec (panel, electronic circuit) a base plate and a cover. The pec assembly consists of two pec, one (Unit 5b) is secured by circlips to pillars located on the other (Unit 5a). Connections to external equipment are provided by a multi-way socket on Unit 5a.

Table 2

Unit 5 integrated circuits - Typical test data

Test conditions, normal working with 6V Rx load engaged. All voltage measured w.r.t. Unit 5a pin 9 (earth).

ML Pin No.	DC voltages at			
	Unit 5a ML1	Unit 5a ML2	Unit 5b ML1	Unit 5b ML2
1	5.7	2.8	5.7	0
2	18	8.9	9.1	0.65
3	5.7	9.3	9.3	0.65
4	22	12	12	0
5	-	-	-	-
6	23	12.5	12.5	-
7	20	10	10	5.7
8	5.7	5.9	5.6	0
9	20	2.0	4.9	-
10	0	0	0	-

COMPONENTS LIST

15. The principal component parts of the Power Supply Unit 640/1/09593 (see Fig.3) are:

Base	640/1/09701
Cover assembly	640/1/10088
Assembly of PEC	640/1/14895

16. The principal component parts of the Assembly of PEC 640/1/14895 (see Fig.3) are:

Panel, Electronic Circuit (Unit 5a)	419/1/12025
Panel, Electronic Circuit (Unit 5b)	419/1/12020
Ring Retaining	994/4/00467/002

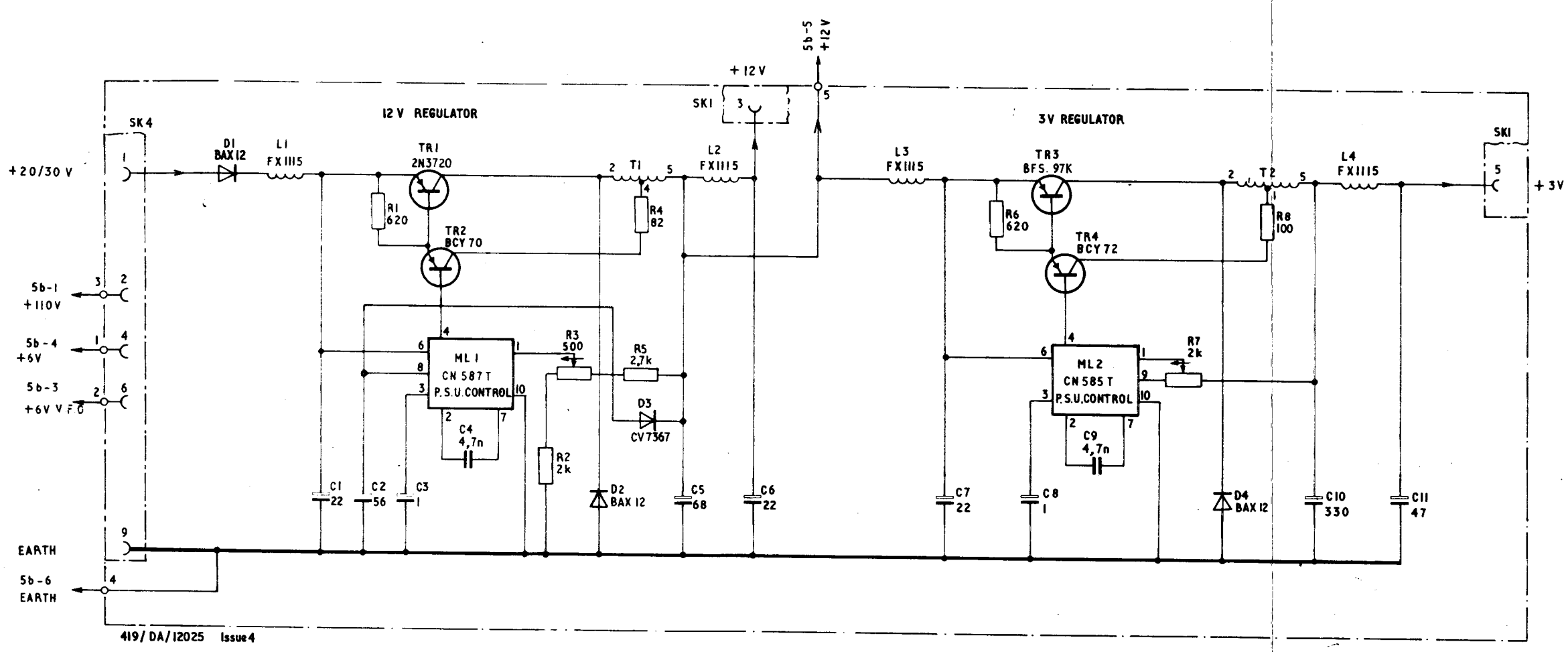
A detailed breakdown of Units 5a and 5b are given on the following pages.

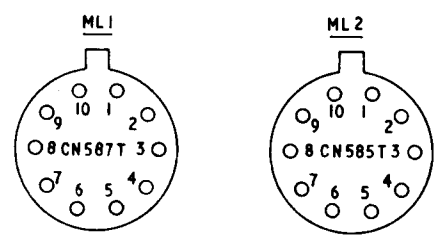
17. The principal component parts of the Panel, Electronic Circuit 419/1/12025 (Unit 5a) (see Fig.5) are:

Cct.Ref.	Description	Reference No.
Resistors		
R1	620 ohm ± 2% 0.25W	403/4/05522/620
R2	2k ohm ± 2% 0.25W	403/4/05523/200
R3	500 ohm ± 10% 0.5W variable	404/9/05033/001
R4	82 ohm ± 2% 0.25W	403/4/05521/820
R5	2.7k ohm ± 2% 0.25W	403/4/05523/270
R6	620 ohm ± 2% 0.25W	403/4/05522/620
R7	2k ohm ± 10% 0.5W variable	404/9/05033/003
R8	100 ohm ± 2% 0.25W	403/4/05522/100
Capacitors		
C1	22 uF ± 10% 35V electrolytic	402/4/56322/220
C2	56 uF ± 10% 6V electrolytic	402/4/55722/560
C3	1 uF ± 10% 35V electrolytic	402/4/56321/100
C4	4.7 nF ± 10% 100V	400/4/19313/470
C5	68 uF ± 10% 16V electrolytic	402/4/55732/680
C6,7	22 uF ± 10% 6V electrolytic	402/4/55732/220
C8	1 uF ± 20% 35V electrolytic	402/4/56321/100
C9	4.7 nF ± 10% 100V	400/4/19313/470
C10	330 uF ± 10% 6V electrolytic	402/4/55723/330
C11	47 uF ± 10% 6V electrolytic	402/4/55722/470
Inductors		
L1 to 4	Inductor 150 uH	406/8/11040
Semi-conductor devices		
TR1	Transistor 2N3720	417/4/00241
TR2	Transistor BCY70	417/4/01721/001
TR3	Transistor BFS97K	417/4/00256
TR4	Transistor BCY72	417/4/01721/003
D1,2,4	Diode BAX12	415/4/05451
D3	Diode C756	415/4/98869
ML1	Integrated circuit CN 587T	446/4/00416
ML2	Integrated circuit CN 585T	446/4/00415
Miscellaneous		
T1	Transformer	406/8/11033/001
T2	Transformer	406/8/11033/003
SK	Socket, receptacle, electrical	508/9/21650
	Screw, slotted ch.hd., M2 x 10 mm, cad. plate st.	991/4/01547/059
	Washer, crinkle, 8BA, Ber.Cu.	991/4/01269/020
	Washer, bright, small, 8BA, cad. plate st.	991/4/00413/001
	Nut, hex., M2, st.st.	991/4/01495/002

18. The principal component parts of the Panel, Electronic Circuit 419/1/12030 (Unit 5b) (see Fig.4) are:

Cct.Ref.	Description	Reference No.
Resistors		
R1	620 ohm ± 2% 0.25W	403/4/05522/620
R2	91 ohm ± 2% 0.25W	403/4/05521/910
R3	1k ohm ± 2% 0.25W	403/4/05523/100
R4	1k ohm ± 5% 0.5W variable	404/9/05033/002
R5	Part of printed circuit	
R6	82 ohm ± 2% 0.25W	403/4/05521/820
R7	470k ohm ± 2% 0.5W	403/4/05325/470
R8	22k ohm ± 2% 0.25W	403/4/05524/220
R9	470k ohm ± 2% 0.5W	403/4/05325/470
R10	1M ohm ± 2% 0.5W	403/4/05326/100
R11	20k ohm ± 10% 0.5W variable	404/9/05033/005
R12	43k ohm ± 2% 0.25W	403/4/05524/430
Capacitors		
C1	22 uF ± 10% 6V electrolytic	402/4/55732/220
C2	4.7 uF ± 10% 10V electrolytic	402/4/56301/470
C3	1 uF ± 10% 35V electrolytic	402/4/56321/100
C4	4.7 nF ± 10% 100V	400/4/19313/470
C5	330 uF ± 10% 6V electrolytic	402/4/55723/330
C6	3.6 uF ± 20% 125V electrolytic	402/9/98190/075
C7	47 nF ± 20% 50V	400/4/20544/470
C8	1.7 uF ± 10% 125V electrolytic	402/9/98190/074
C9	220 nF ± 10% 250V	435/4/90380/220
Inductors		
L1	Inductor 150 uH	406/8/11040
Semi-conductor devices		
TR1	Transistor BFS97K	417/4/00256
TR2	Transistor BCY72	417/4/01721/003
TR3	Transistor BC107	417/4/02028/001
TR4	Transistor C648 (BSY95A)	417/4/98681
TR5	Transistor U14906/4	417/4/05089
TR6,7	Transistor FRB700	417/4/00255
D1	Diode C756	415/4/98869
D2	Diode BAX12	415/4/05451
D3 to 6	Diode BAX16	415/4/05449
D7	Diode BAX12	415/4/05451
ML1	Integrated circuit CN 587T	446/4/00416
ML2	Integrated circuit CN 497T	446/4/00429
Transformers		
T1	Transformer	406/8/11033/002
T2	Transformer	406/8/11032/003





VIEWS ON PIN ENDS

Fig.1
Issue 2

Unit 5a, power supply +12V & +3V — circuit

Fig.1
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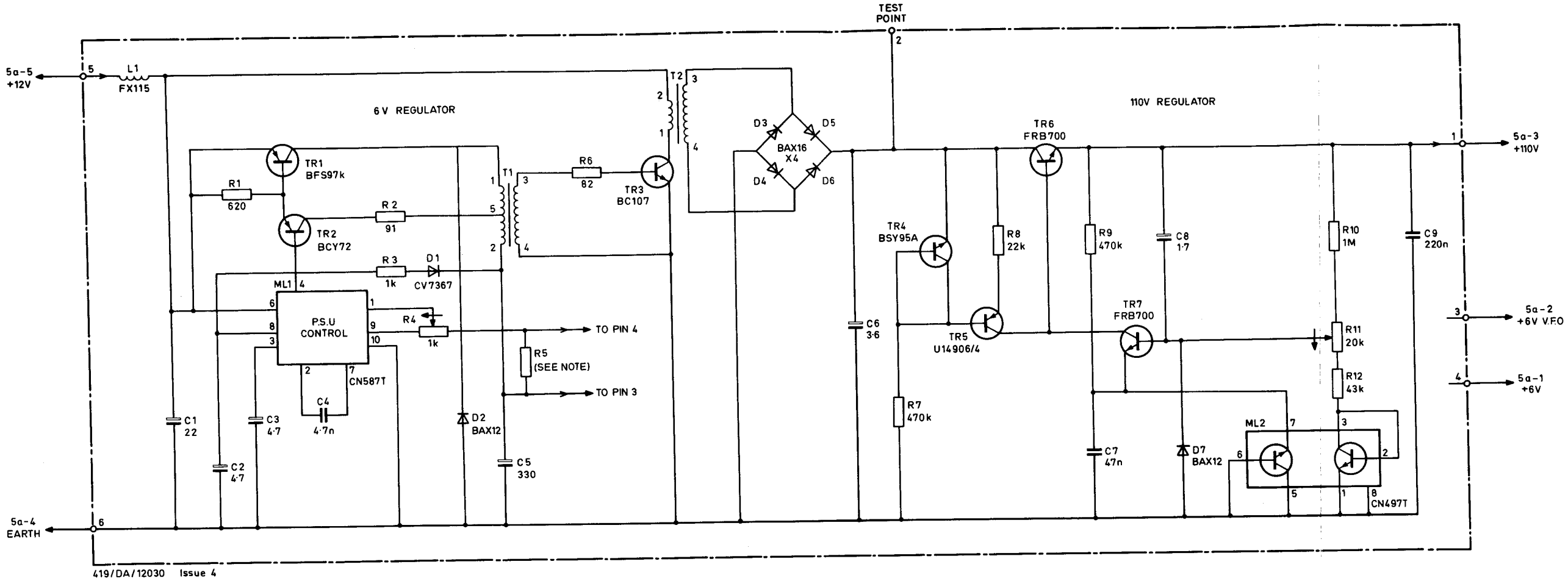

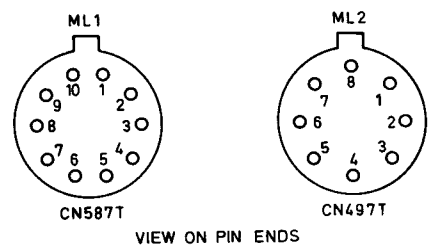

Unit 5b, power supply + 6V & +110V - circuit

Fig. 2
Issue 3

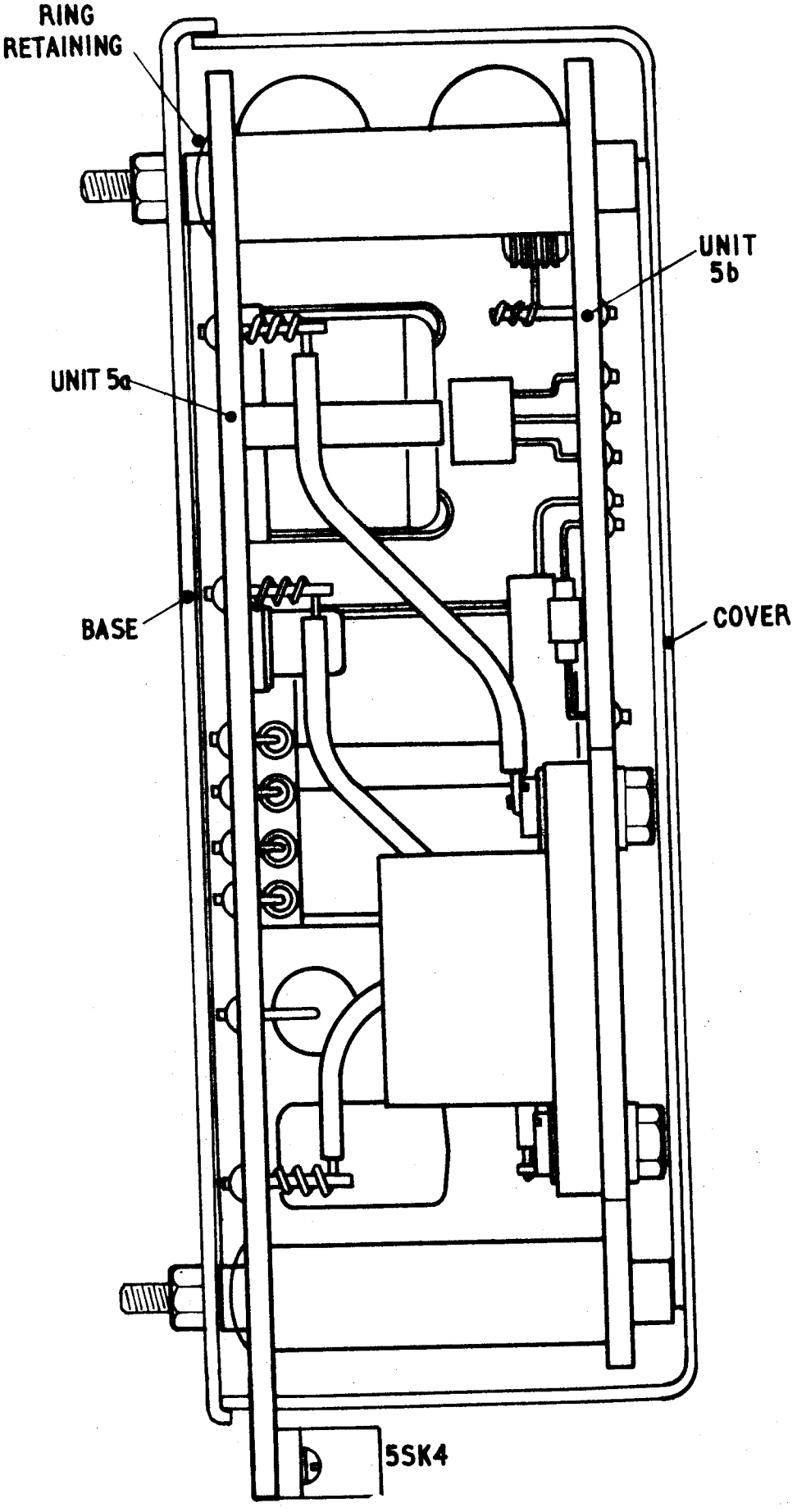

Fig. 3 Power supply unit assembly (unit 5)

THIRD LINE SERVICING

OF

SCREEN & CAN ASSEMBLY 640/1/09705

(Unit 6a)

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	Para.
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Fault Finding	7
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ILLUSTRATIONS

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2	Receiver IF PEC (Unit 6a) - component layout	7

DESCRIPTION

1. The Screen and Can Assembly (Unit 6a) is a component part of the transmitter/receiver and provides receiver IF stages. The unit is normally located on a Mother Panel (Unit 6).

2. The unit consists of a screening can and a panel, electronic circuit (pec). All the circuit components are located on the pec. Holes are drilled in the screening can to allow access for adjustment of tuning.

3. A circuit diagram of the unit is given in Fig.1. A pre-amplifier TR1 and two integrated circuit amplifiers, ML1, ML2, are connected in cascade. ML1 and ML2 are each followed by a tuned circuit. Provision is made for AGC, the control voltage being routed to ML1 pin 7.

4. The gain of TR1 is set by means of a wire link connection to select the appropriate emitter load; this selection is carried out when setting up the complete receiver.

5. The module frequency response is centred on 1.75 MHz with an effective bandwidth of 23 kHz. The maximum gain (AGC input 0V) is greater than 70 dB with the appropriate link connected.

TESTING

6. Before Unit 6a can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

FAULT FINDING

7. The information given in Tables 1 and 2 is intended to aid diagnosis of a fault; it provides the nominal voltages between designated points, related to specific test conditions.

Table 1

Unit 6a - Typical d.c. test voltages

Conditions as for "6.0V line current measurement" test.
Measurements w.r.t. TXP (earth) on Unit 6a.

Measure at	Volts
ML1/2	6
ML1/3	1.8
ML1/5,6	0.75
ML1/7	0

Measure at	Volts
ML2/2	6
ML2/3	1.8
ML2/5,6	0.75

Measure at	Volts
R1/R2	1.4
TR1c/R3	5.2

Table 2

Unit 6a - Typical i.f. test voltages

Conditions as for "IF alignment and gain" test.
Measurements w.r.t. TPX (earth) on Unit 6a.

Measure at	i.f. (mV)
R1/R2	0.4
TR1c/R3	0.2
L2 pin 1	6.8
L2 pin 2	220

COMPONENTS LIST

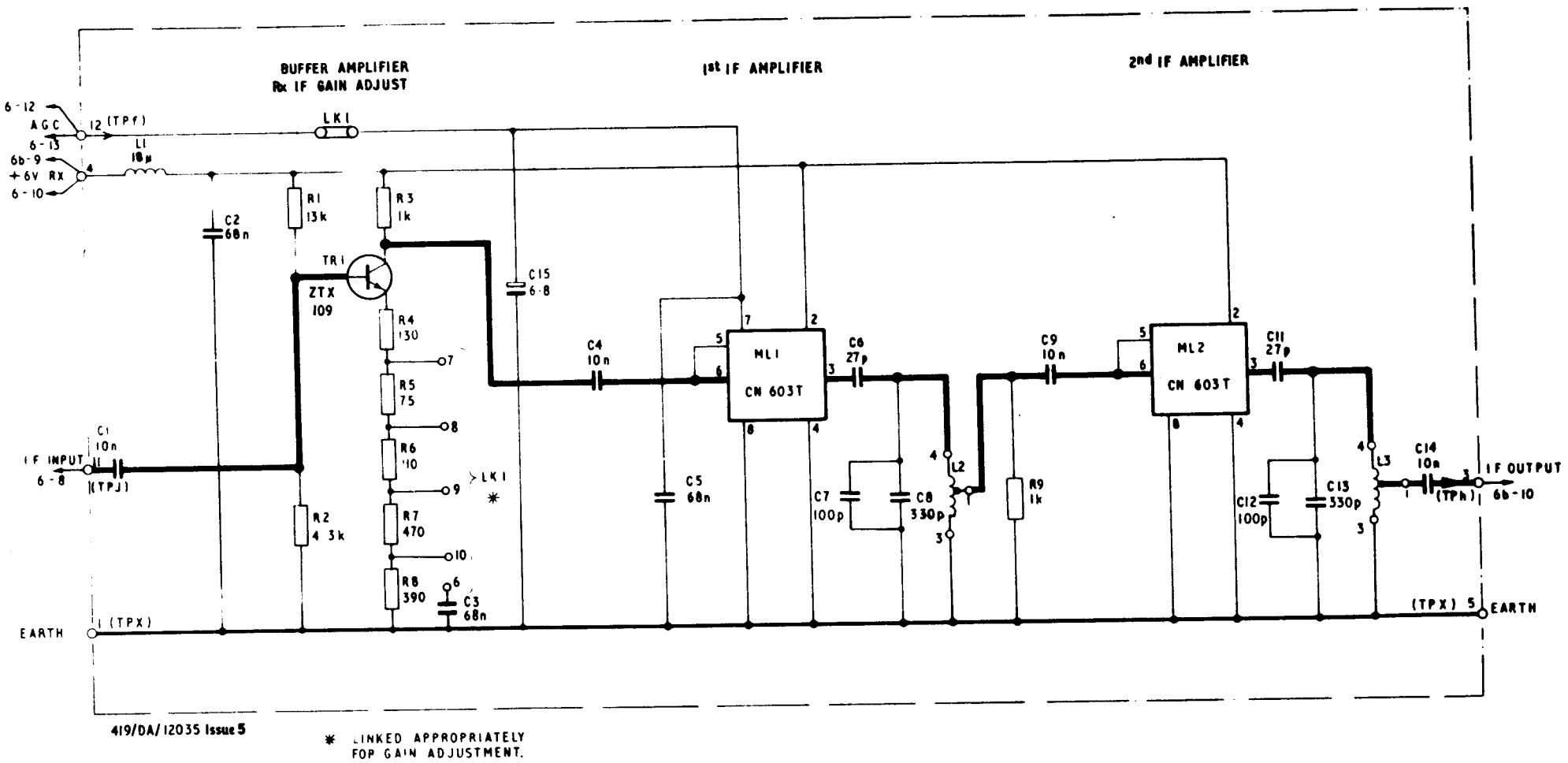
8. The component parts of the Screen and Can Assembly (Unit 6a) 640/1/09705 are:

Screen Can	640/1/09824
Panel, Electronic Circuit	419/1/12035
Spacer	640/2/15412

9. A detailed breakdown of the Panel, Electronic Circuit 419/1/12035 is given below and the component layout is given on Fig.2.

Cct.Ref.	Description	Reference No.
Resistors		
R1	13k ohm ± 2% 0.25W	403/4/05524/130
R2	4.3k ohm ± 2% 0.25W	403/4/05523/430
R3,9	1k ohm ± 2% 0.25W	403/4/05523/100
R4	130 ohm ± 2% 0.25W	403/4/05522/130
R5	75 ohm ± 2% 0.25W	403/4/05521/750
R6	110 ohm ± 2% 0.25W	403/4/05522/110
R7	470k ohm ± 2% 0.25W	403/4/05525/470
R8	390 ohm ± 2% 0.25W	403/4/05522/390

Cct.Ref.	Description	Reference No.
Capacitors		
C1	10 nF ± 20% 100V	400/4/20544/100
C2,3	68 nF ± 20% 50V	400/4/20544/680
C4	10 nF ± 20% 100V	400/4/20544/100
C5	68 nF ± 20% 50V	400/4/20544/680
C6	27 pF ± 5% 100V	400/9/20436
C7	100 pF ± 5% 100V	400/9/20437
C8	330 pF ± 1% 350V	424/9/98027/105
C9	10 nF ± 20% 100V	400/4/20544/100
C10	Not used	
C11	27 pF ± 5% 100V	400/9/20436
C12	100 pF ± 5% 100V	400/9/20437
C13	330 pF ± 1% 350V	424/9/98027/105
C14	10 nF ± 20% 100V	400/4/20544/100
C15	6.8 uF ± 10% 6V electrolytic	402/4/55721/680
Inductors		
L1	Inductor R.F., 18 uH ± 10%	406/9/08470/027
L2,3	Inductor R.F.	406/8/11030/001
Semi-conductor devices		
TR1	Transistor ZTX 109	417/4/02027/003
ML1,2	Integrated circuit	446/4/00423



419/DA/12035 Issue 5

* LINKED APPROPRIATELY FOR GAIN ADJUSTMENT.

ML1 & ML2

VIEW ON PIN END

Unit 6a, receiver IF stages circuit

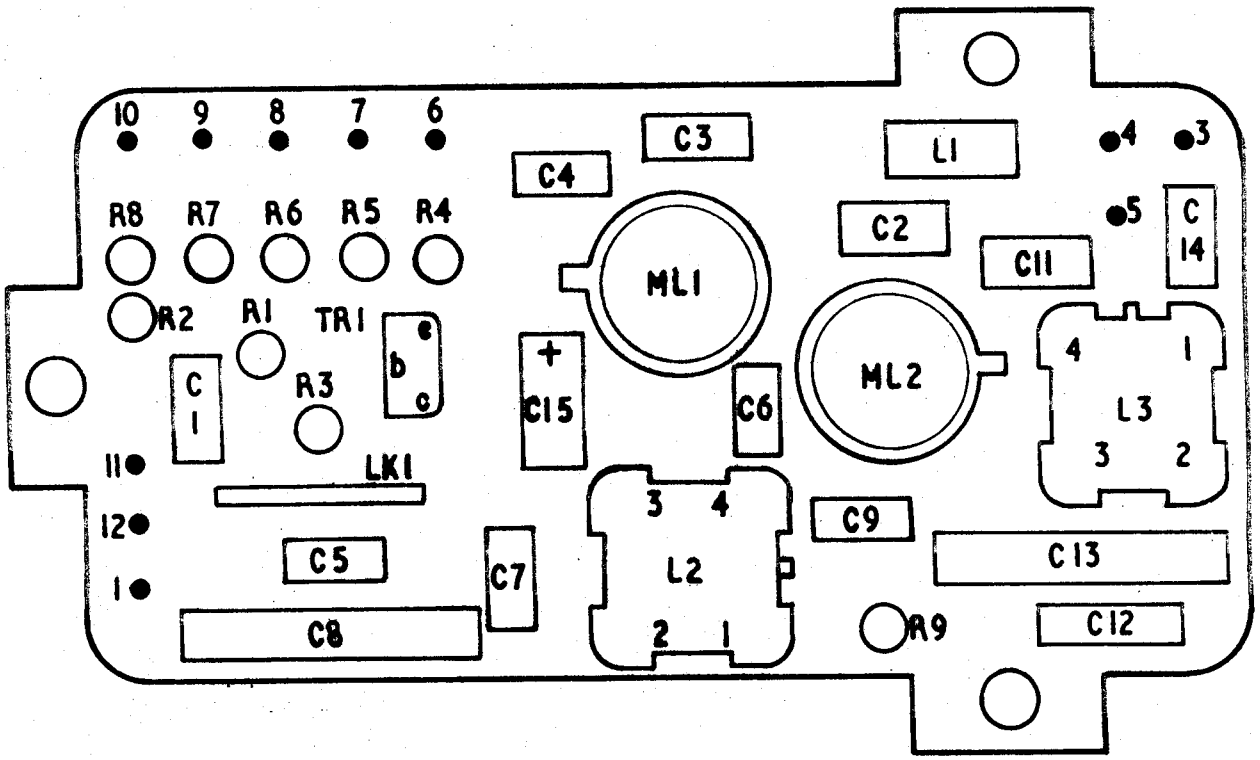


Fig.2 Receiver I F pcb (unit 6a) – component layout

THIRD LINE SERVICING

OF

SCREEN & CAN ASSEMBLY 640/1/09706

(Unit 6b)

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DESCRIPTION

Introduction

1. The Screen and Can Assembly (Unit 6b) is a component part of the transmitter/receiver and provides the receiver AF and AGC unit. The unit is normally located on a mother panel (Unit 6).

2. The unit consists of a screening can and a panel, electronic circuit (pec). All the circuit components are located on the pec. The circuit diagram is given in Fig.1.

3. The unit provides the following functions:

(1) SSB demodulation and AGC generation.

(2) AM demodulation and AGC generation.

(3) Amplification of selected demodulator AF output.

(4) Injection of a tone to audio amplifier input under external control.

(5) Injection of audio (Tx sidetone) into audio amplifier input.

Demodulation and AGC Generation

4. SSB demodulation is provided by integrated circuit, ML1, which also provides AM demodulation and AM AGC generation. A second integrated circuit, ML2, provides SSB AGC generation.

5. SSB IF signals applied to ML1 pin 9 beat with a 1.75 MHz carrier reinsertion signal applied to ML1 pin 6. The difference frequency at ML1 pin 8 is the AF component of the SSB signal and is routed via the emitter follower TR1 to:

(1) Integrated circuit ML2, which produces the SSB AGC voltage at ML2 pin 2. The SSB AGC threshold level, is set by R4.

(2) Gate TR3 (see paragraph 8).

6. AM IF signals applied to ML1 pin 9 are rectified to provide an AF output at ML1 pin 1. This output is routed via the emitter follower TR2 to the gate TR4 (see paragraph 8). The AM AGC voltage is produced at ML1 pin 4 and is derived from the IF carrier. The AM AGC threshold level is set by resistor R2, connected between ML1 pins 2 and 5.

AF Amplifiers

7. Either the demodulated SSB or the demodulated AM, as selected by a gate circuit, is routed via preamplifier to the external gain control and thence to a class AB audio amplifier. Other signals to this amplifier are provided by a tone gate and the sidetone input.

8. TR3/TR4 form a gate to select either the demodulated SSB applied to TR3 base or the demodulated AM applied to TR4 base. When the +6V Rx (AM) input to pin 6 of Unit 6b is open circuit, the bias conditions are such that TR3 passes the demodulated SSB to TR5 and TR4 is switched off. If the +6V Rx (AM) input is at +6V, TR4 is switched on to pass the demodulated AM to TR5 and TR4 emitter current causes TR3 to be biased beyond cut-off. Resistors R5 and R11 provide independent adjustments of the AF input levels to TR3 and TR4.

9. The +6V at the +6V Rx (AM) input is taken via the isolating diode D3 to pin 16 of the unit where it is externally used to inhibit the carrier insertion signal (i.e. SSB demodulation is inhibited when AM Receive is selected).

10. The AF signal selected by TR3/TR4 is amplified by TR5 and TR6 and passed via an external gain control to TR8. Other AF inputs to TR8 are provided by the tone gate TR7 and the sidetone input to pin 4 of Unit 6b.

11. TR8/TR9 are driver stages for the class AB audio amplifier TR10/TR11.

12. The amplitude of sidetone input at TR8 base is reduced when the 0V CW input to pin 3 of Unit 6b is connected to 0V.

Tone Gate

13. The tone gate is provided to facilitate the transmitter-receiver frequency check and loss of phase lock warning functions. The gate passes a tone to the audio amplifier input when either one of two control signals is applied.

14. The tone applied to pin 15 of Unit 6b is passed to the base of TR7 which is normally biased beyond cut-off. IF +6V is applied to pin 6 (Rx Freq Check)

or to pin 2 (Phase Lock) open circuited TR7 is switched on and the tone is passed to the audio amplifier input.

15. An open circuit at pin 2 (Phase Lock Input) causes +6V to be applied via R40 and the isolating diode D4 to pin 16 of Unit 6b where it is externally used to inhibit the Tx and Rx IF carrier.

TESTING

16. Before Unit 6b can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

FAULT FINDING

17. The information given in Tables 1 and 2 is intended to aid diagnosis of the location of a fault; it provides the nominal voltage levels between designated points, related to specific test conditions as obtained with the relevant test configuration in Part 4.

Table 1

Unit 6b - Typical d.c. test data for fault finding

Conditions as for "Line current" test.
Measurements w.r.t. TPX (earth) on Unit 6b.

Measure at	d.c. volts
ML1/1	0.7
ML1/2	0.7
ML1/3	0.96
ML1/4	0.25
ML1/5	0.70
ML1/6	3.1
ML1/7	6
ML1/8	4.3
ML1/9	1.3

Measure at	d.c. volts
ML2/1	1.2
ML2/2	0
ML2/3	0.97
ML2/4	6
ML2/5	0
ML2/6	0

Table 2

Unit 6b - Typical test data for fault finding

Voltages measured w.r.t. TPX (earth) on Unit 6b.

Conditions as for test	Measure at	d.c. volts*	a.f. volts
AF output AM circuit	TR2b/R8	1.9	0.038
	TR4b/R13	1.1	-
	TR3b/R16	0.93	-
	TR5b	1.3	0.17
	TR6b	4.1	0.79
	TPm	-	0.77
	Pin 13	-	0.77
	TR11b	1.8	2.5
	TR10b/R33	3.1	2.1
	R38/R39	2.5	1.8
AF output SSB circuit	TR1b	4.4	0.042
	TR3b/R16	1.1	-
	TR4b/R13	0.89	-
AGC SSB circuit	TR1b	4.4	0.074
	C9 +ve	1.1	0.018
Tone gate (AF O/P high)	TR7e/R30	3.8	0.049
Tone gate (AF O/P low)	TR7e/R30	0	0

*Remove input signal to measure d.c. level when necessary.

COMPONENTS LIST

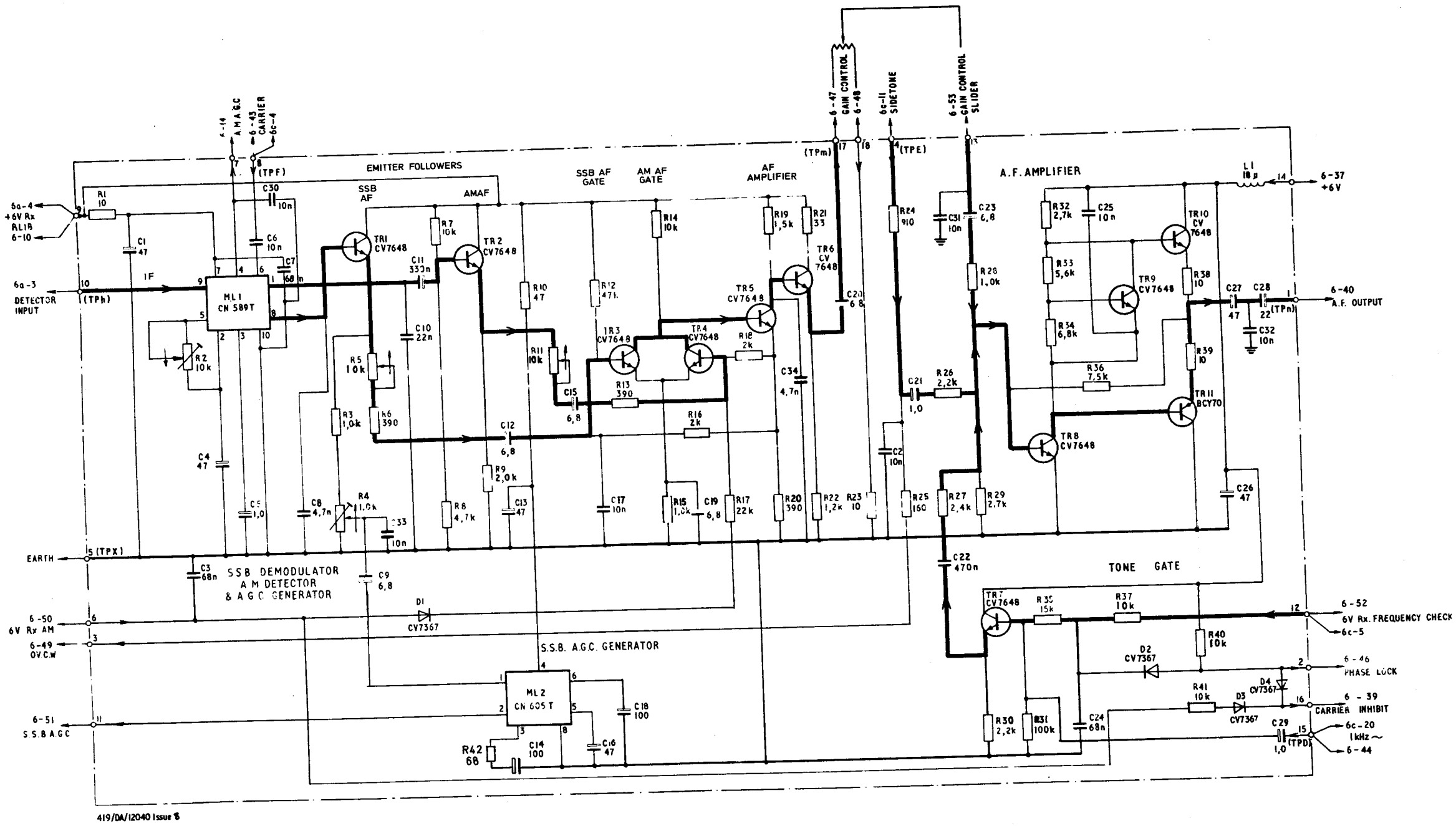
18. The component parts of the Screen and Can Assembly (Unit 6b) 640/1/09706 are:

Screen Can	640/1/09825
Panel Electronic Circuit	419/1/12040
Spacer	640/2/15412

19. A detailed breakdown of the Panel, Electronic Circuit 419/1/12040 is given below and the component layout is given on Fig.2.

Cct.Ref.	Description	Reference No.
Resistors		
R1	10 ohm ± 2% 0.25W	403/4/05521/100
R2	10k ohm ± 10% 0.5W variable	404/9/05033/004
R3	1k ohm ± 2% 0.25W	403/4/05523/100
R4	1k ohm ± 10% 0.5W variable	404/9/05033/002
R5	10k ohm ± 10% 0.5W variable	404/9/05033/004
R6	390 ohm ± 2% 0.25W	403/4/05522/390
R7	10k ohm ± 2% 0.25W	403/4/05524/100
R8	4.7k ohm ± 2% 0.25W	403/4/05523/470
R9	2k ohm ± 2% 0.25W	403/4/05523/200
R10	47 ohm ± 2% 0.25W	403/4/05521/470
R11	10k ohm ± 10% 0.5W variable	404/9/05033/004
R12	47k ohm ± 2% 0.25W	403/4/05524/470
R13	390 ohm ± 2% 0.25W	403/4/05522/390
R14	10k ohm ± 2% 0.25W	403/4/05524/100
R15	1k ohm ± 2% 0.25W	403/4/05523/100
R16	2k ohm ± 2% 0.25W	403/4/05523/200
R17	22k ohm ± 2% 0.25W	403/4/05524/220
R18	2k ohm ± 2% 0.25W	403/4/05523/200
R19	1.5k ohm ± 2% 0.25W	403/4/05523/150
R20	390 ohm ± 2% 0.25W	403/4/05522/390
R21	33 ohm ± 2% 0.25W	403/4/05521/330
R22	1.2k ohm ± 2% 0.25W	403/4/05523/120
R23	10 ohm ± 2% 0.25W	403/4/05521/100
R24	910 ohm ± 2% 0.25W	403/4/05522/910
R25	160 ohm ± 2% 0.25W	403/4/05522/160
R26	2.2k ohm ± 2% 0.25W	403/4/05523/220
R27	2.4k ohm ± 2% 0.25W	403/4/05523/240
R28	1k ohm ± 2% 0.25W	403/4/05523/100
R29	2.7k ohm ± 2% 0.25W	403/4/05523/270
R30	2.2k ohm ± 2% 0.25W	403/4/05523/220
R31	100k ohm ± 2% 0.25W	403/4/05525/100
R32	2.7k ohm ± 2% 0.25W	403/4/05523/270
R33	5.6k ohm ± 2% 0.25W	403/4/05523/560
R34	6.8k ohm ± 2% 0.25W	403/4/05523/680
R35	15k ohm ± 2% 0.25W	403/4/05524/150
R36	7.5k ohm ± 2% 0.25W	403/4/05523/750
R37	10k ohm ± 2% 0.25W	403/4/05524/100
R38,39	10 ohm ± 2% 0.25W	403/4/05521/100
R40,41	10k ohm ± 2% 0.25W	403/4/05524/100
R42	68 ohm ± 1% 0.25W	403/4/05511/680
Capacitors		
C1	47 uF ± 10% 6V electrolytic	402/4/55722/470
C2	10 nF ± 20% 100V	400/4/20544/100
C3	68 nF ± 20% 50V	400/4/20544/680
C4	47 uF ± 10% 6V electrolytic	402/4/55722/470
C5	1 uF ± 10% 35V electrolytic	402/4/56321/100
C6	10 nF ± 20% 100V	400/4/20544/100
C7	68 nF ± 20% 50V	400/4/20544/680
C8	4.7 nF ± 10% 100V	400/4/19313/470
C9	6.8 uF ± 10% 6V electrolytic	402/4/55721/680
C10	22 nF ± 10% 100V	400/4/19494/220

Cct.Ref.	Description	Reference No.
Capacitors (continued)		
C11	330 nF ± 10% 35V electrolytic	402/4/56320/330
C12	6.8 uF ± 10% 6V electrolytic	402/4/55721/680
C13	47 uF ± 10% 6V electrolytic	402/4/55722/470
C14	100 uF ± 10% 10V electrolytic	402/4/56303/100
C15	6.8 uF ± 10% 6V electrolytic	402/4/55721/680
C16	47 uF ± 10% 6V electrolytic	402/4/55722/470
C17	10 nF ± 20% 100V	400/4/20544/100
C18	100 uF ± 10% 10V electrolytic	402/4/56303/100
C19,20	6.8 uF ± 10% 6V electrolytic	402/4/55721/680
C21	1 uF ± 10% 35V electrolytic	402/4/56321/100
C22	470 nF ± 20% 50V	400/4/20495/470
C23	6.8 uF ± 10% 6V electrolytic	402/4/55721/680
C24	68 nF ± 20% 50V	400/4/20544/680
C25	10 nF ± 20% 100V	400/4/20544/100
C26,27	47 uF ± 10% 35V electrolytic	402/4/55722/470
C28	22 uF ± 10% 35V electrolytic	402/4/56322/220
C29	1 uF ± 10% 35V electrolytic	402/4/56321/100
C30	10 nF ± 20% 100V	400/4/20544/100
C31	10 nF ± 10% 100V	400/4/19314/100
C32,33	10 nF ± 20% 100V	400/4/20544/100
C34	4.7 nF ± 10% 100V	400/4/19313/470
Inductors		
L1	Inductor 18 uH	406/9/08470/027
Semi-conductor devices		
TR1 to 10	Transistor C648 (BSY95A)	417/4/98681
TR11	Transistor BCY70	417/4/01721/001
D1 to 4	Diode C756	415/4/98869
ML1	Integrated circuit CN 589T	446/4/00417
ML2	Integrated circuit CN 605T	446/4/00424



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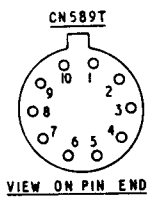

VIEW ON PIN END

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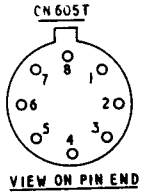


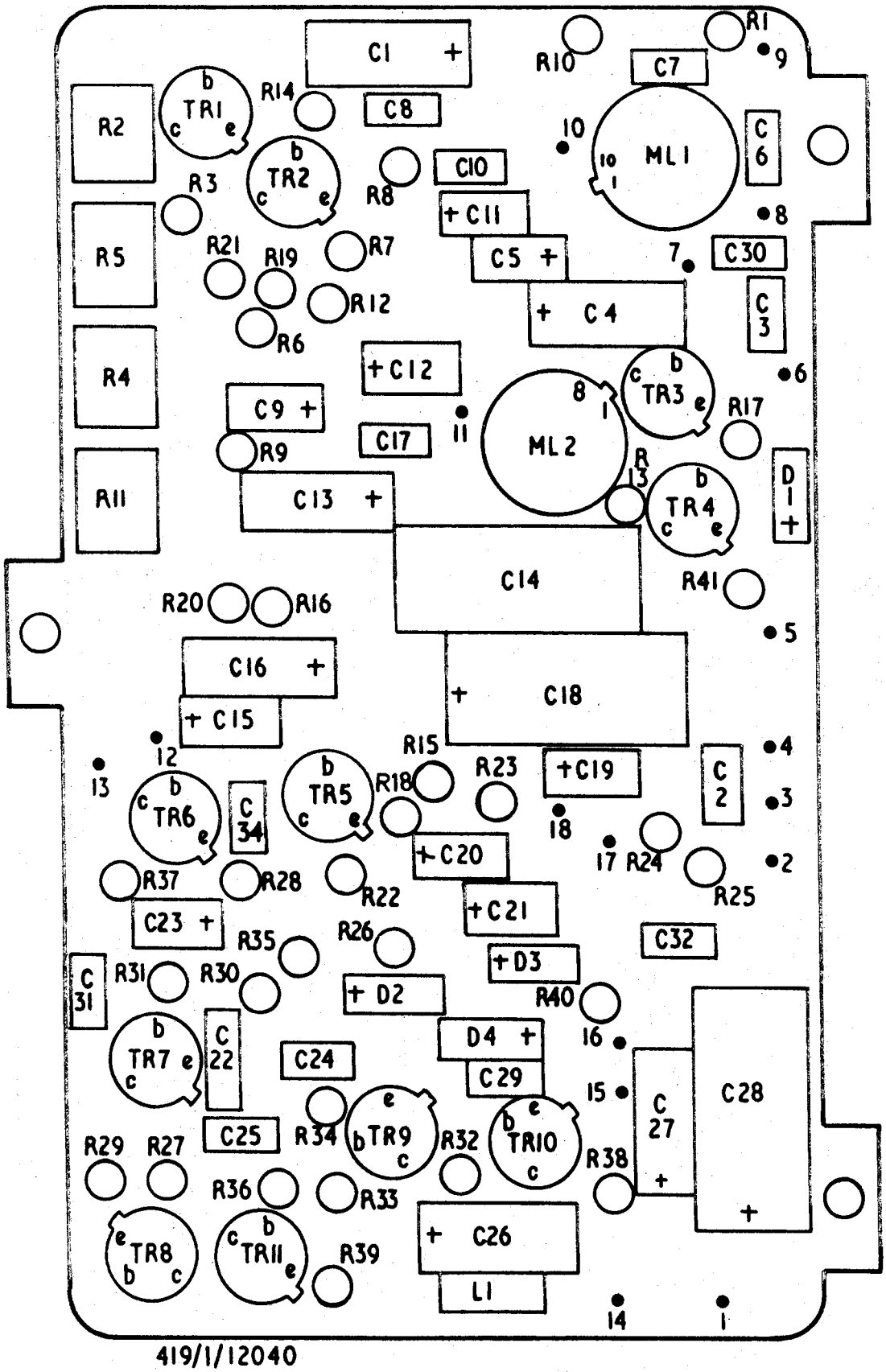
VIEW ON PIN END

Unit 6b, receiver demodulator and AF amplifier – circuit

Fig.1

Issue 3

Fig.1



419/1/12040

Fig.2 Receiver AF and AGC pcb (unit 6b) – component layout

THIRD LINE SERVICING

OF

SCREEN & CAN ASSEMBLY 640/1/09707

(Units 6c/d)

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DESCRIPTION

Introduction

1. The Screen and Can Assembly (Unit 6c/d) is a component part of the transmitter/receiver; it provides the transmitter audio circuits, AF/IF mixer and pressel circuits. The unit is normally located on a mother panel (Unit 6).

2. The unit consists of a panel electronic circuit (pec) assembly and screening can. The pec assembly comprises two pec (Units 6c and 6d), secured to each other at separating spacers. All external connections are via Unit 6c; connections to Unit 6d are by wire leads to terminals on Unit 6c.

3. Circuit diagrams of Unit 6c and Unit 6d are given in Figs.1 and 2 respectively.

Audio Circuits (refer to Fig.1)

4. Unit 6c provides a 300 ohm balanced input impedance for speech signals from a microphone. These signals are applied to an integrated circuit, ML1, which provides two audio amplifiers, one for a main signal path and one for a sidetone path.

5. The sidetone path amplifier in ML1 has a constant gain of approx. 30 dB. The main path amplifier in ML1 incorporates a VOGAD (voice operated gain adjusting device) which provides a constant output level (90 mV rms nominal) for input signals in the range 100 uV to 100 mV peak-to-peak.

6. Main path speech signals are routed from ML1 pin 9 to ML3 pin 6. Sidetone path speech is routed from ML1 pin 4 to ML2 pin 6.

7. Integrated circuits ML2 and ML3 are identical controlled gates which incorporate amplifiers (whose gain can be set externally) and symmetrical limiting stages. ML2 output provides the Tx sidetone (normally passed to Rx audio circuits in Unit 6b) and ML3 output provides the audio signal to the modulator circuits in Unit 6d. Both gates operate in the following manner:

(1) ML2 will not pass audio signals when there is OV at pin 12 of Unit 6c.

(2) ML2 and ML3 will pass speech signals from ML1 when pins 12, 15 and 16 of Unit 6c are all open circuit.

(3) ML2 and ML3 will pass an audio tone at 2 kHz applied to pin 20 of Unit 6c when pin 12 of the unit is open circuit and any of pins 15, 16 is at +6V.

8. The control input to pin 12 of Unit 6c is provided by Unit 6d and is determined by the pressel input to that unit (para.16); when the pressel is set to transmit, audio is passed by ML2 and ML3. The control of inputs to pins 15 and 16 of Unit 6c is from external switches.

9. Two separate tone inputs are provided so that each input can be externally set to a level appropriate to the respective output path, main or sidetone.

Modulator Circuits (see Fig.2)

10. Audio from Unit 6c and a 1.75 MHz carrier from an external oscillator are applied to a double balanced modulator in ML1 of Unit 6d. The output produced at ML1 pin 6 is a complex waveform which contains the sum and difference frequencies of these signals, the original frequencies are effectively suppressed within ML1.

11. The modulator output is routed via a clipping stage and a switched gain amplifier, both in the integrated circuit ML3. The signal is routed out of ML3 at pin 7 and back again at pin 2. At this link, a connection is made to transistor TR4. This transistor is operated by the pressel and provides keying of the transmitter IF signal (para.17).

12. The clipping of audio signals in ML3 of Unit 6c, together with the clipping of peaks of the modulator output signal within ML3 of 6d is to ensure that the peak-to-mean ratio of the transmitter IF signal is decreased enabling the transmitter power amplifiers to give a higher mean power output. Switching of ML3 gain enables the output signal to be approximately the same peak-to-peak amplitude on all modes of operation; selection of gain is by external control applying the following to pins of Unit 6d:

(1) +6V to pin 2 for SSB modes.

(2) +6V to pins 3 and 4 for CW modes.

(3) Open circuit at pins 2, 3 and 4 for AM modes.

Fine setting of the gain for AM signals is provided by R8, and for CW(N) by R9.

13. For reinsertion of 1.75 MHz carrier into the IF signal on AM modes, a gate in ML3 is operated for AM mode and passes the 1.75 MHz carrier from pin 5 to pin 3 of ML3 where it is taken via pin 5 of Unit 6e (where it is added to the single sideband IF signal to produce compatible AM). Potentiometer R3 provides setting of the carrier level and thereby sets the modulation depth.

Pressel Circuits

14. The pressel circuits, in conjunction with an external pressel switch, provide switching of the radio from transmit to receive and vice versa.

15. The pressel is connected to pin 8 of Unit 6d. When this input is open circuit (Rx), transistors TR2 and TR3 conduct. When this input is 0V (Tx), transistors TR2 and TR3 are switched off.

16. The sidetone outputs from Unit 6c are keyed by the control input to pin 12 of that unit (paras.7 and 8). This control input is provided by TR3 in Unit 6d, the control is open circuit when TR3 is switched off (Tx), thereby switching on the sidetone outputs; the control is at 0V when TR3 is switched on (Rx), thereby switching off the sidetone output.

17. Keying of transmitter IF signal by TR4 (para.11) is controlled by the voltage at TR2 emitter. When TR2 is switched on (Rx), its output causes TR4 to switch on, thereby switching off the transmitter IF; when TR2 is switched off (Tx), its output causes TR4 to switch off, thereby switching on the transmitter IF.

18. Changing over of the radio from transmit mode to receive mode and vice versa is provided by external circuits which respond to a relay drive provided by ML2 in Unit 6d. This integrated circuit is controlled by the collector voltage at transistor TR2. When TR2 is switched off (Tx), approx. +6V is applied to pin 5 of ML2, causing a heavy current to be supplied by ML2 to any relay circuits connected to pin 10 of Unit 6d. This drive is removed when ML2 pin 5 is set to approx. 1V by conduction of TR2 (Rx).

19. Keying of the sidetone and the transmitter IF provides the marks and spaces of the morse message. Reversion of the radio to receive condition on CW modes when the pressel is released for the formation of a space is prevented by a delay (0.25 - 0.75 sec) between release of pressel and removal of Tx supplies. This delay is provided by capacitor C2 when pin 12 of Unit 6d is connected to 0V.

TESTING

20. Before Units 6c/d can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

FAULT FINDING

21. The information given in Tables 1 and 2 is intended to aid diagnosis of the location of a fault; it provides the nominal voltage levels between designated points, related to specific test conditions as obtained with the relevant test configuration in Part 4.

Table 1

Unit 6c/6d - Typical d.c. voltages

Conditions as for "sidetone output level (AM)" test but with AFG set to minimum output level.
Voltages measured w.r.t. TPX (earth) on Unit 6c or 6d.

Integrated Circuit Pin	d.c. voltages at					
	6cML1	6cML2	6cML3	6dML1	6dML2	6dML3
1	6	Earth	Earth	Earth	1.2	5.2
2	2.1	5.2	6	5.2	6	0.73
3	4.9	5.0	5.2	2.7	1.7	0.77
4	3.7	4.0	4.0	6	4.8	Earth
5	0.85	6	6	5.6	1.1	0.68
6	0.85	1.4	1.4	4.7	0	6
7	Earth	1.4	1.4	2.7	0	4.6
8	1.3	0	0	Earth	0	4.7
9	1.3	0	0	-	-	4.7
10	0	0	0	-	-	0
11	-	-	-	-	-	0
12	-	-	-	-	-	0
13	-	-	-	-	-	0
14	-	-	-	-	-	0.50

Table 2

Unit 6c/6d - Typical i.f./a.f. test voltages

Voltages measured w.r.t. TPX (earth) on Unit 6c.

Conditions as for test	Measure at	level (mV)
Sidetone output level (AM)	6cML1 pin 4	400
IF output level (SSB)	6cTPG	100
IF output level (SSB)	6c pin 14	400 p-p
IF output level (SSB)	6dML1 pin 6	800 p-p
IF output level (CW)	6c pin 14	400 p-p
IF output level (CW)	6dML1 pin 6	800 p-p

COMPONENTS LIST

22. The principal component parts of the Screen and Can Assembly 630/1/37537 (Unit 6c/d) are:

Pec Assembly	630/1/37539
Spacer	640/2/15412
Screen Can	630/1/37451

23. The principal component parts of the PEC Assembly 630/1/37539 are:

Panel Electronic Circuit (Unit 6c)	419/1/12045
Panel Electronic Circuit (Unit 6d)	419/1/51369
Spacer	640/2/09898

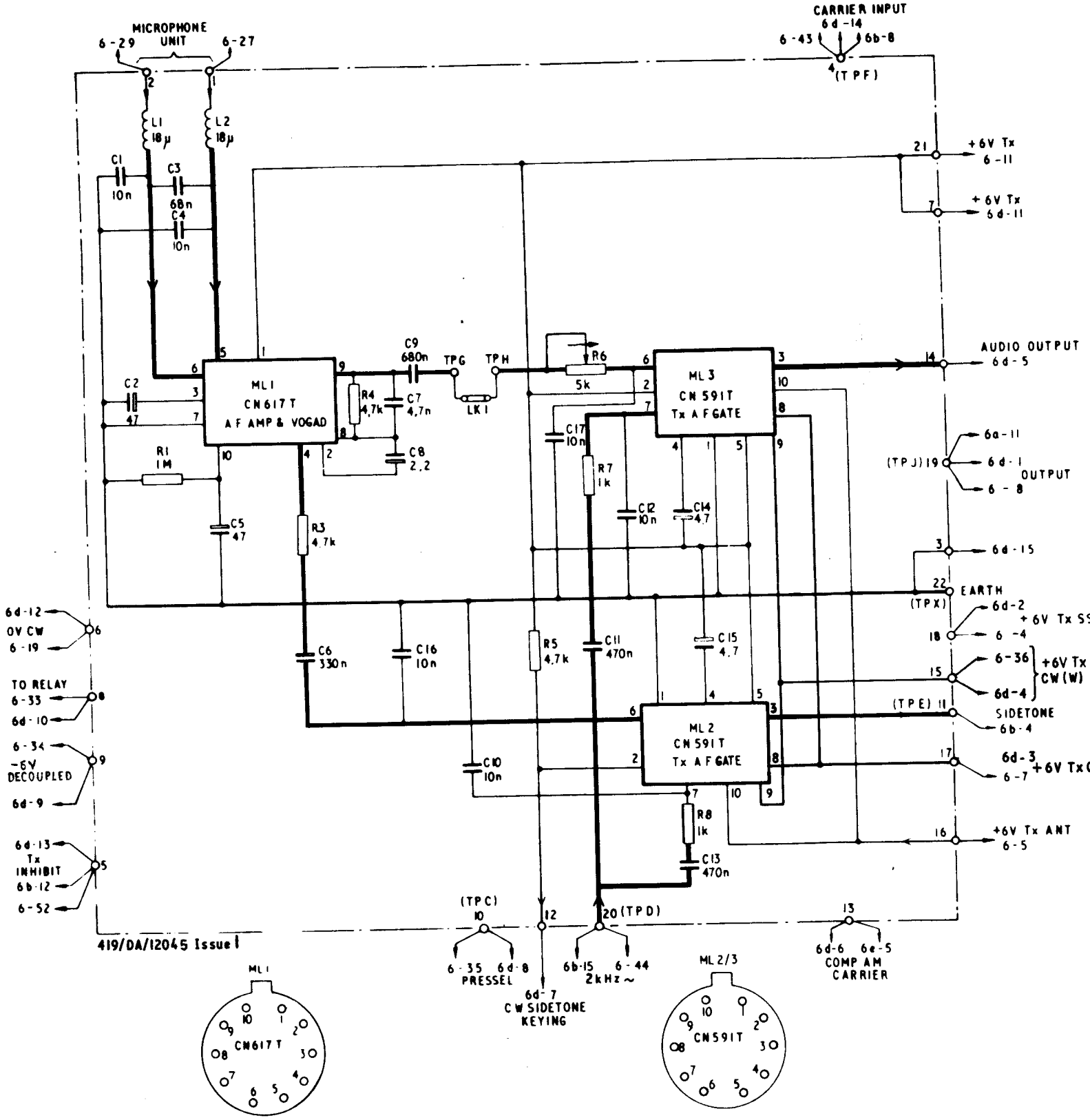
A breakdown of the two pec is given on the following pages

24. The principal component parts of Unit 6c are listed below and the component layout is given in Fig.4.

Cct.Ref.	Description	Reference No.
Resistors		
R1	1M ohm ± 2% 0.5W	403/4/05326/100
R2	Not used	
R3 to 5	4.7k ohm ± 2% 0.25W	403/4/05523/470
R6	5k ohm ± 10% 0.5W variable	404/9/05032/005
R7,8	1k ohm ± 2% 0.25W	403/4/05523/100
Capacitors		
C1,4,10,12,16,17	10 nF ± 20% 100V	400/4/20544/100
C2,5	47 uF ± 10% 6V electrolytic	402/4/55722/470
C3	68 nF ± 20% 50V	400/4/20544/680
C6	330 nF ± 10% 35V electrolytic	402/4/56320/330
C7	4.7 nF ± 10% 100V	400/4/19313/470
C8	2.2 uF ± 10% 20V electrolytic	402/4/56311/220
C9	680 nF ± 20% 50V	400/9/19296/001
C11,13	470 nF ± 20% 50V	400/4/20495/470
C14,15	4.7 uF ± 10% 10V electrolytic	402/4/56301/470
Inductors		
L1,2	Inductor 18 uH	406/9/08470/027
Semi-conductor devices		
ML1	Integrated circuit CN617T	446/4/00428
ML2,3	Integrated circuit CN591T	446/4/00418

25. The principal component parts of Unit 6d are listed below and the component layout is given in Fig.3.

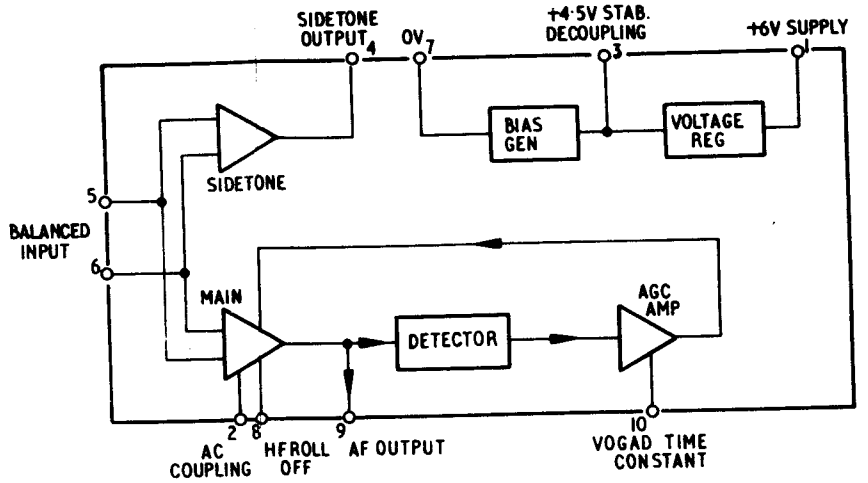
Cct.Ref.	Description	Reference No.
Resistors		
R1	15k ohm ± 2% 0.25W	403/4/05524/150
R2,7	10k ohm ± 2% 0.25W	403/4/05524/100
R3,9	5k ohm ± 10% 0.5W variable	403/9/05032/005
R4	4.7k ohm ± 2% 0.25W	403/4/05523/470
R5,11	22k ohm ± 2% 0.25W	403/4/05524/220
R6	1.5k ohm ± 2% 0.25W	403/4/05523/150
R8	1k ohm ± 10% 0.5W variable	404/9/05032/003
R10	750 ohm ± 2% 0.25W	403/4/05522/750
Capacitors		
C1	4.7 uF ± 10% 10V electrolytic	402/4/56301/470
C2	47 uF ± 10% 6V electrolytic	402/4/55722/470
C3,7 to 10	10 nF ± 20% 100V	400/4/20544/100
C4 to 6,11	68 nF ± 20% 50V	400/4/20544/680
Semi-conductor devices		
TR1 to 4	Transistor CV648	417/4/98681
D1,3	Diode CV7367	415/4/98869
D2	Diode LR360C, zener 36V	415/9/02775/022
ML1	Integrated circuit CN609T	446/4/00426
ML2	Integrated circuit CN581T	446/4/00413
ML3	Integrated circuit CN593F	446/4/00412



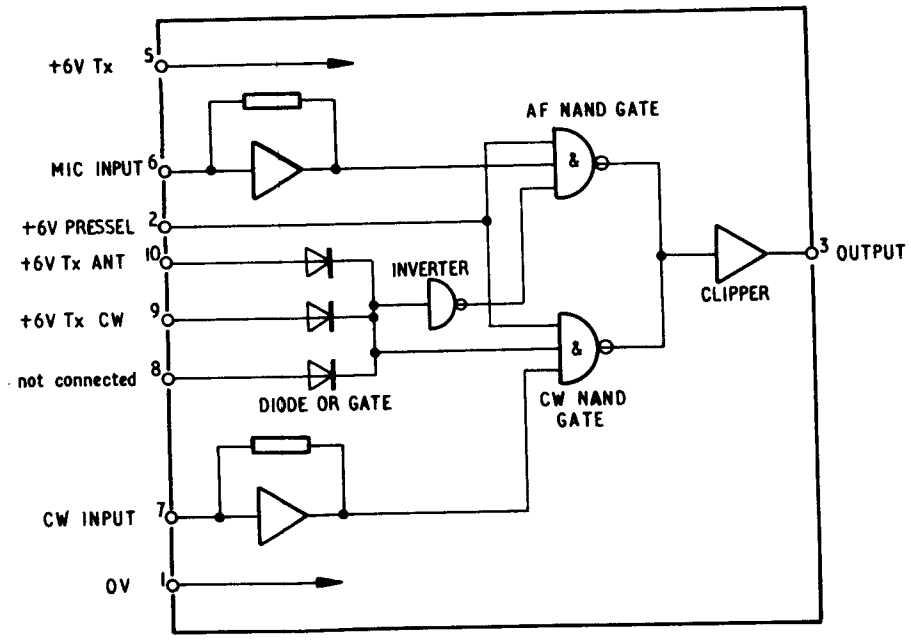
Unit 6c. transmitter AF and gating - circuit

Fig. 1

July 81

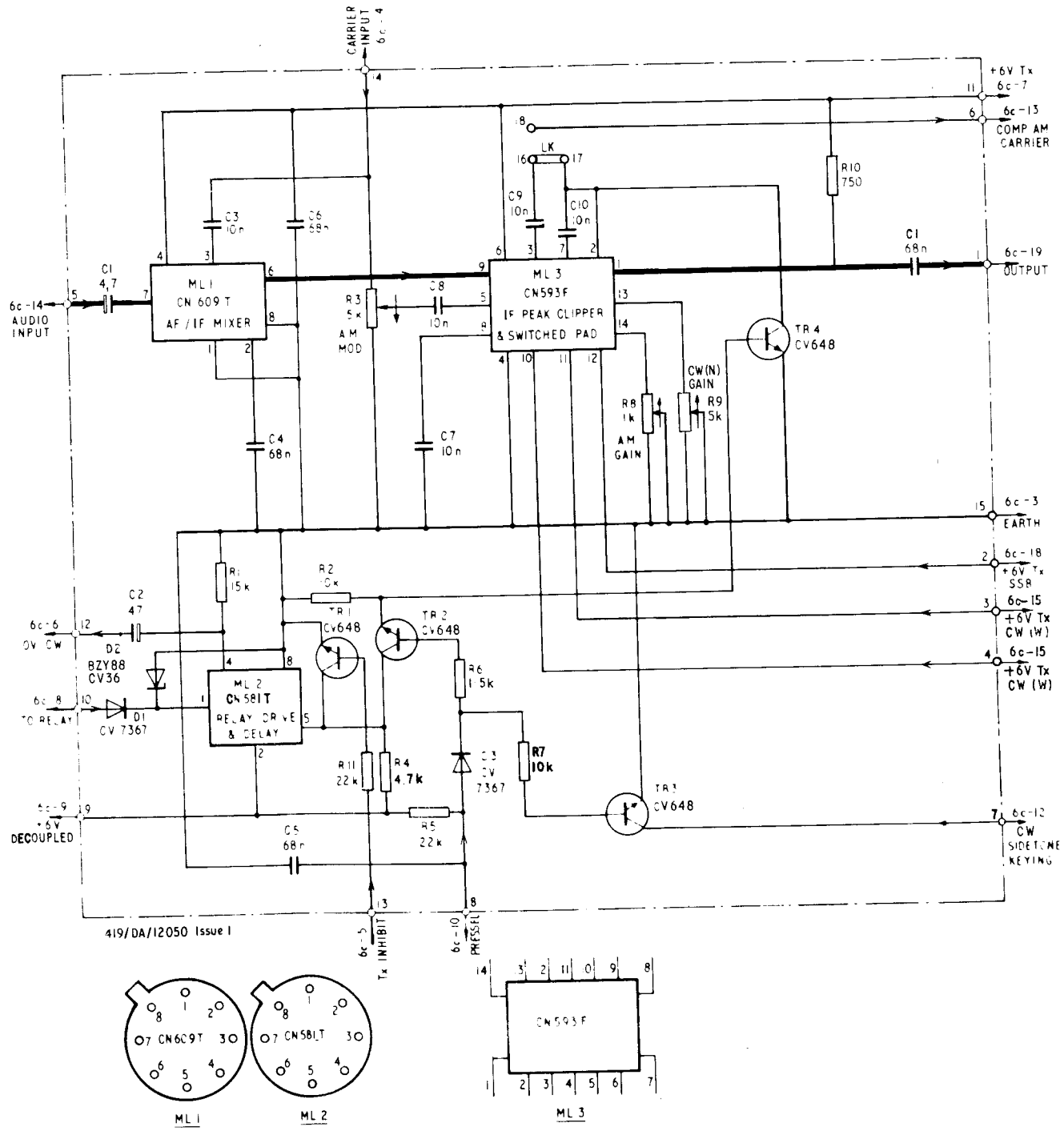


MLI AF Amp and VOGAD-functional block



ML2 & ML3 Tx AF Gate - functional block

Fig. 1



Unit 6d. transmitter AF to IF and relay drive circuit

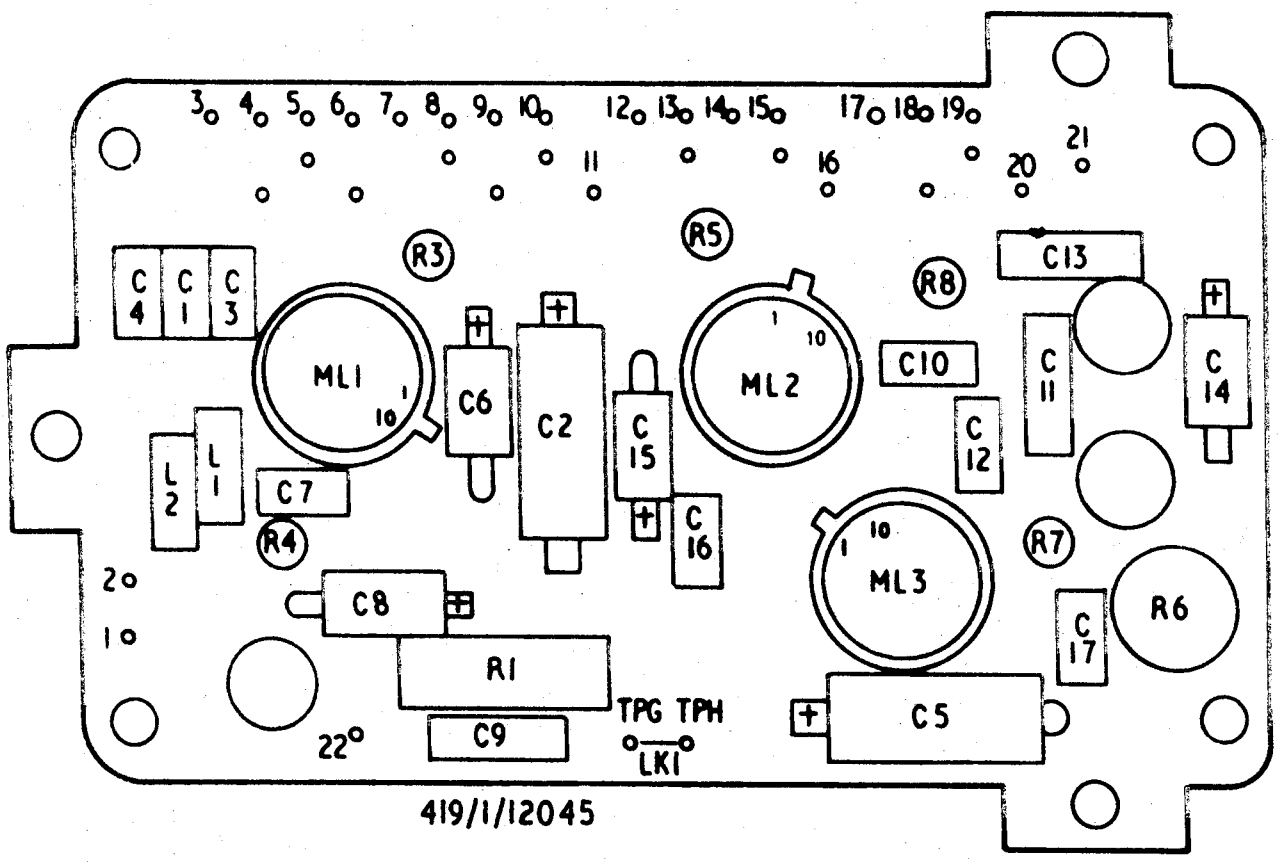


Fig.3 Transmitter AF and gating pec (unit 6c)- component layout

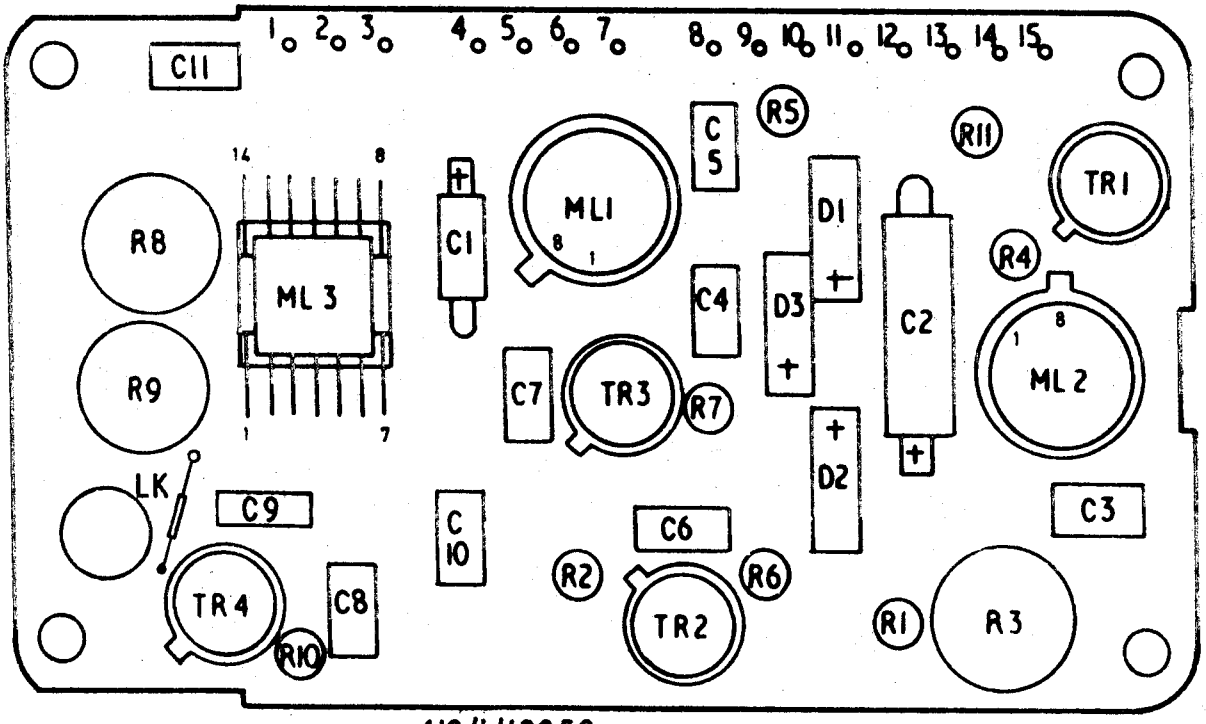


Fig.4 Transmitter AF to IF pec (unit 6d)- component layout

THIRD LINE SERVICING

OF

SCREEN & CAN ASSEMBLY 630/1/09708

(Units 6e)

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DESCRIPTION

1. The Screen and Can Assembly (Unit 6e) is a component part of the transmitter/receiver and provides the transmitter IF/RF mixer. The unit is normally located on a mother panel (Unit 6).

2. The unit consists of a screening can and a panel electronic circuit (pec). All the circuit components are located on the pec. The circuit diagram is given in Fig.1.

3. Inputs to this unit are:

   (1) To pin 7; either an amplitude modulated 1.75 MHz carrier (AM mode) or the lower sideband of a 1.75 MHz carrier (all other modes).

   (2) To pin 3; the output from the VFO (Unit 3h), which is (calling the panel set frequency 'f0') for a +1.75 MHz in AM mode and f0 +1.748 MHz in all other modes.

4. The IF signal is amplified by TR1 and routed to integrated circuit ML1 via emitter follower TR2. The gain of TR1 is set by linking a selection of resistors R4, 5 & 6 which adjusts the amount of negative feedback between TR2 emitter and TR1 base. This adjustment is carried out when setting up the complete transmitter.

5. Integrated circuit ML1 is a double balanced modulator which performs the function of IF/RF mixer. The IF from TR2 is mixed in ML1 with an RF in the range 3.748 MHz to 31.75 MHz supplied to pin 3 of the unit.

6. ML1 output is taken from the unit via TR5. This output is a complex waveform which contains the sum and difference frequencies of the inputs; the original frequencies are suppressed in ML1. Only the difference frequency component of the output is utilised; the sum frequencies are rejected at later stages of the transmitter.

TESTING

7. Before Unit 6e can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

FAULT FINDING

8. The information given in Tables 1 and 2 is intended to aid diagnosis of the location of a fault, and provides the nominal voltage levels between designated points related to specific test conditions as obtained with the relevant test configuration in Part 4.

Table 1

Unit 6e - d.c. test voltages

Conditions as for "d.c. supply current" test.
Voltages measured w.r.t. TPX (earth) on Unit 6e.

ML1 pin	Volts
1,8	Earth
2	2.7
3	2.7
4	6
5	5.3
6	4.5
7	2.7

Measure at	Volts
R7/R8	5.7
TR3c/R9	1.6
TR1b/R2	0.65
TR1c/R3	1.65

Table 2

Unit 6e - r.f. levels

Conditions as for "conversion gain" test.
Voltages measured w.r.t. TPX (earth) on Unit 6e.

Measured at	r.f. (mV)
Panel pin 12	150
ML1 pin 6	150

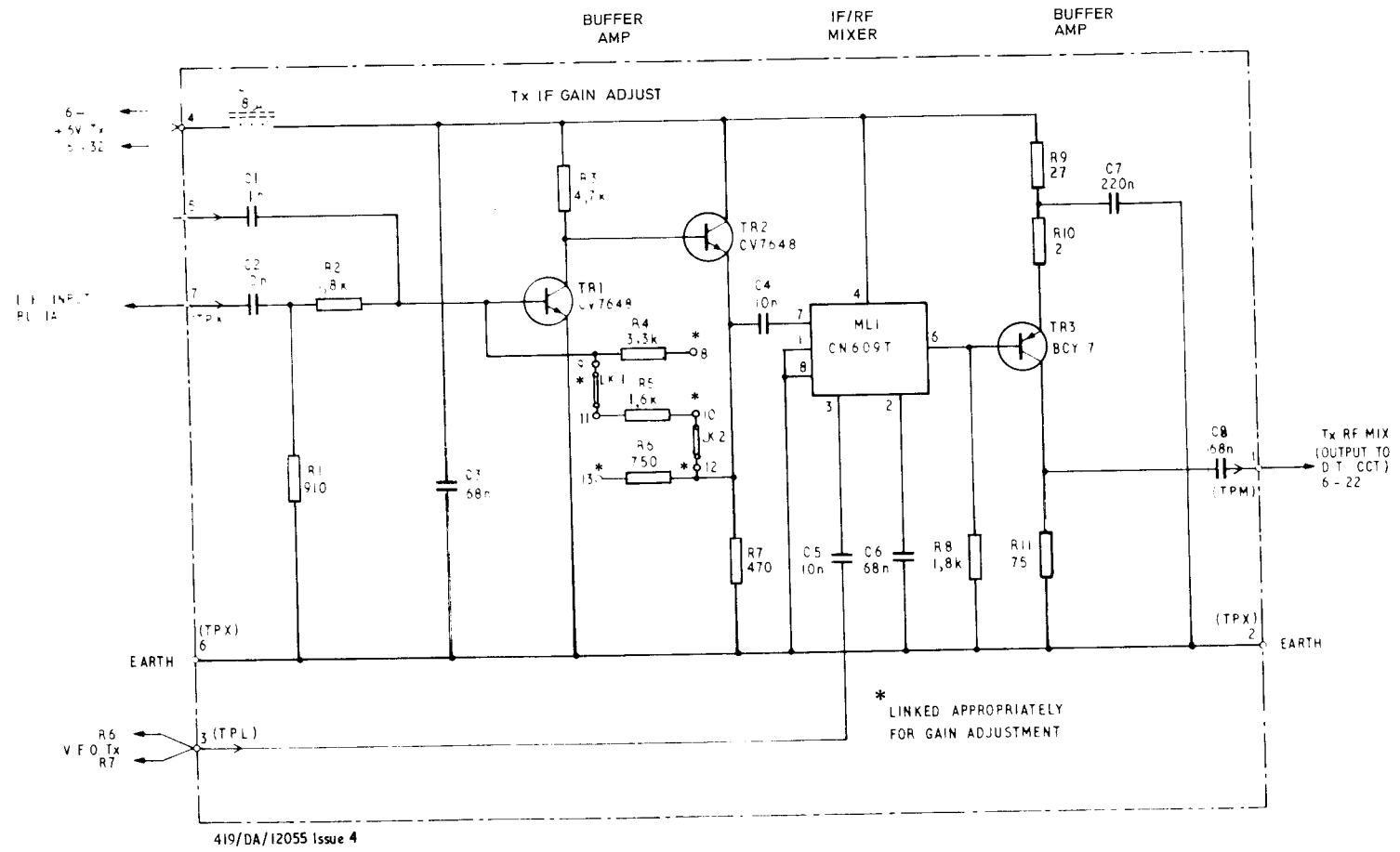
COMPONENTS LIST

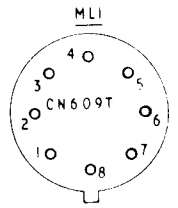
9. The principal component parts of the Screen and Can Assembly (Unit 6e) 630/1/37542 are:

Screen Can	640/1/37443
Panel Electronic Circuit	419/1/51371
Spacer	640/2/15412

10. The component parts of the Panel Electronic Circuit 419/1/51371 are detailed on the following page and the component layout diagram is given on Fig.2.

Cct.Ref.	Description	Reference No.
Resistors		
R1	910 ohm ± 5% 0.25W	403/4/05552/910
R2,8	1.8k ohm ± 5% 0.25W	403/4/05553/180
R3	4.7k ohm ± 5% 0.25W	403/4/05553/470
R4	33k ohm ± 2% 0.25W	403/4/05523/330
R5	1.6k ohm ± 2% 0.25W	403/4/05553/160
R6	750 ohm ± 2% 0.25W	403/4/05552/750
R7	470 ohm ± 5% 0.25W	403/4/05551/120
R9	27 ohm ± 5% 0.25W	403/4/78126/011
R10	12 ohm ± 2% 0.25W	403/4/05521/120
R11	75 ohm ± 2% 0.25W	403/4/05521/750
Capacitors		
C1,2,4,5	10 nF ± 20% 100V	400/4/20544/100
C3,6,8	68 nF ± 20% 50V	400/4/20544/680
C7	220 nF ± 20% 50V	400/4/20495/220
Inductors		
L1	Inductor 18 uH	406/9/08470/027
Semi-conductor devices		
TR1,2	Transistor C648 (BSY95A)	417/4/98681
TR3	Transistor BCY71	417/4/01721/001
ML1	Integrated circuit CN609T	446/4/00426





Transmitter IF/RF mixer – circuit

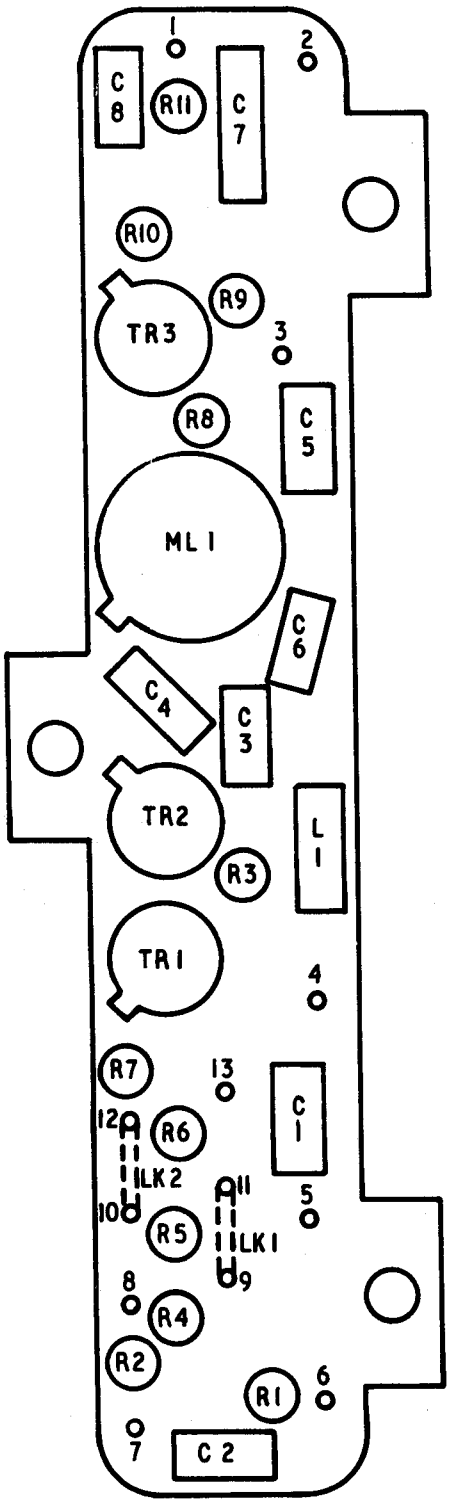


Fig 2 Transmitter IF/RF mixer pec(unit 6e)
component layout

THIRD LINE SERVICING

OF

SYNTHESISER 682/1/00400

(Unit 9)

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INTRODUCTION

1. The Synthesiser (Unit 9) is a component part of the receiver-transmitter and is normally located on the Front Panel and Chassis Assembly (Unit 1).

2. Unit 9 is a module which, together with a voltage controlled variable frequency oscillator (VFO), a reference oscillator and decade switches, forms a loop that automatically sets and maintains the VFO output to any frequency in the range 3.75 MHz to 31.7499 MHz in 100 Hz increments. A facility is provided whereby the VFO output frequency can be sidestepped by -2 kHz.

3. The module consists of six panels, electronic circuit (pec), termed units 9a to 9f, together with an upper baseplate, lower baseplate and a cover. These items are mounted in a stack of four studs attached to the upper base and sealed by a gasket. Unit 9a is located between the upper and lower baseplates and is thereby fully screened. Pins and filter connectors in the lower baseplate provide terminals for external connections. Apart from printed wiring on the pec, all internal interconnections are by soldered wire leads.

DESCRIPTION

General

4. The following description supplements the overall functional description of the synthesiser given in Part 2 of this manual.

5. The functional diagram given on Fig.4 gives a block diagram of each pec and the interconnections; it can be used in support of the pec circuit diagrams on Figs.5 to 10 and the circuit description of each individual pec which follow the principle of operation given on the following pages.

Principle of Operation - Variable Divider

NOTE: The variable divider consists of a number of discrete elements located on Unit 9b. Each element counts its input and produces one output pulse for every 'n' input pulses.

6. Fig.1 shows three counters in cascade. Counters 2 and 3 count to 10 (i.e. ÷10) except when commanded to count to a higher number. Counter 1 counts to a constant number and each of its output pulses commands one extended count at the other two counters.

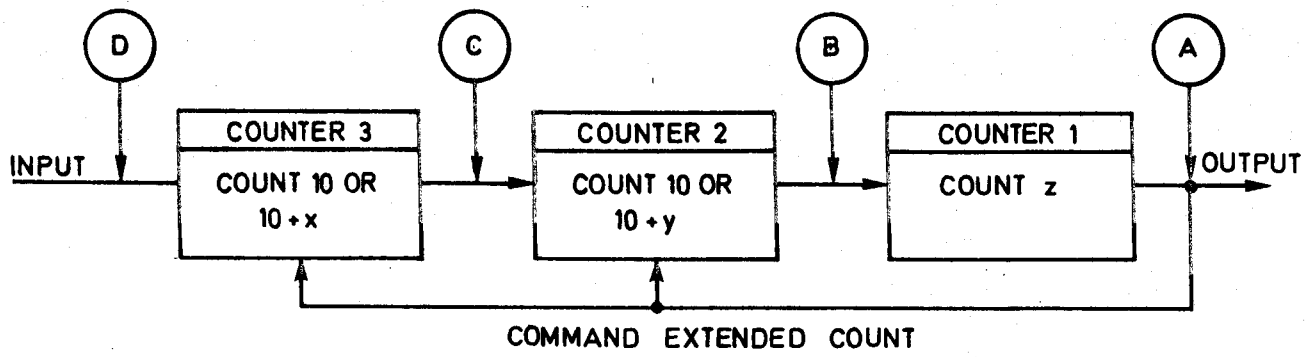


Fig.1 Basic concept - variable divider

7. If the input to counter 3 is pulses at D intervals, its output pulses will occur at C = 10D intervals with a C = (10 + x)D interval when commanded. Similarly counter 2 output pulses occur at B = 10C intervals with an occasional B = (10 + y)C interval. Output of counter 1 will be at intervals A = zB. Since each pulse in counter 1 output causes one extended count at counters 2 and 3, the rate of output from counter 1 will be constant if input to counter 3 is at constant rate.

8. The overall count (division factor) of the divider in Fig.1 can be shown to be 100z + 10y + x and is illustrated by the numerical example below:

If z = 3, y = 2 and x = 5, the overall count is 325 and one full cycle of operation will be:

	Number of input pulses to Counter 3
(1) Pulse from counter 1 causes extended count at counter 2 (÷12) and 3 (÷15).	-
(2) After 15 pulses to counter 3, it reverts to ÷10 and supplies one pulse to counter 2.	15
(3) After 11 more pulses from counter 3, counter 2 reverts to ÷10 and supplies one pulse to counter 1.	110
(4) After 2 more pulses from counter 2 (20 from counter 3) counter 1 produces a pulse.	200
(5) Cycle recommences.	-
	325

9. The counter is made variable by using switches to select the values of terms x, y and z. However, in practice, the counter elements used in the variable divider of Unit 9b each produces a pulse of width not less than 1/f (where f is the counter element input p.r.f.). Hence the duration of output pulse from counter 1 could be far too great to ensure that only a single extended count occurs at counters 1 and 2.

10. Figure 2 illustrates a means of ensuring that each counter performs only one extended count when commanded. When the count in counter 1 reaches the value of term z, counter 1 produces a recognition signal (REC) which causes counter 2 to perform an extended count during which, counter 2:

(1) Applies a recognition signal to counter 3.

(2) Causes the recognition signal from counter 1 to be reset.

Counter 3 similarly responds to its recognition signal input, performing an extended count and resetting the recognition signal from counter 2.

11. Instead of using the very wide pulse from counter 1 for the counter output, a more suitable narrow pulse, at the same p.r.f., is derived by counter 3 when it reaches a particular count during its recognition phase.

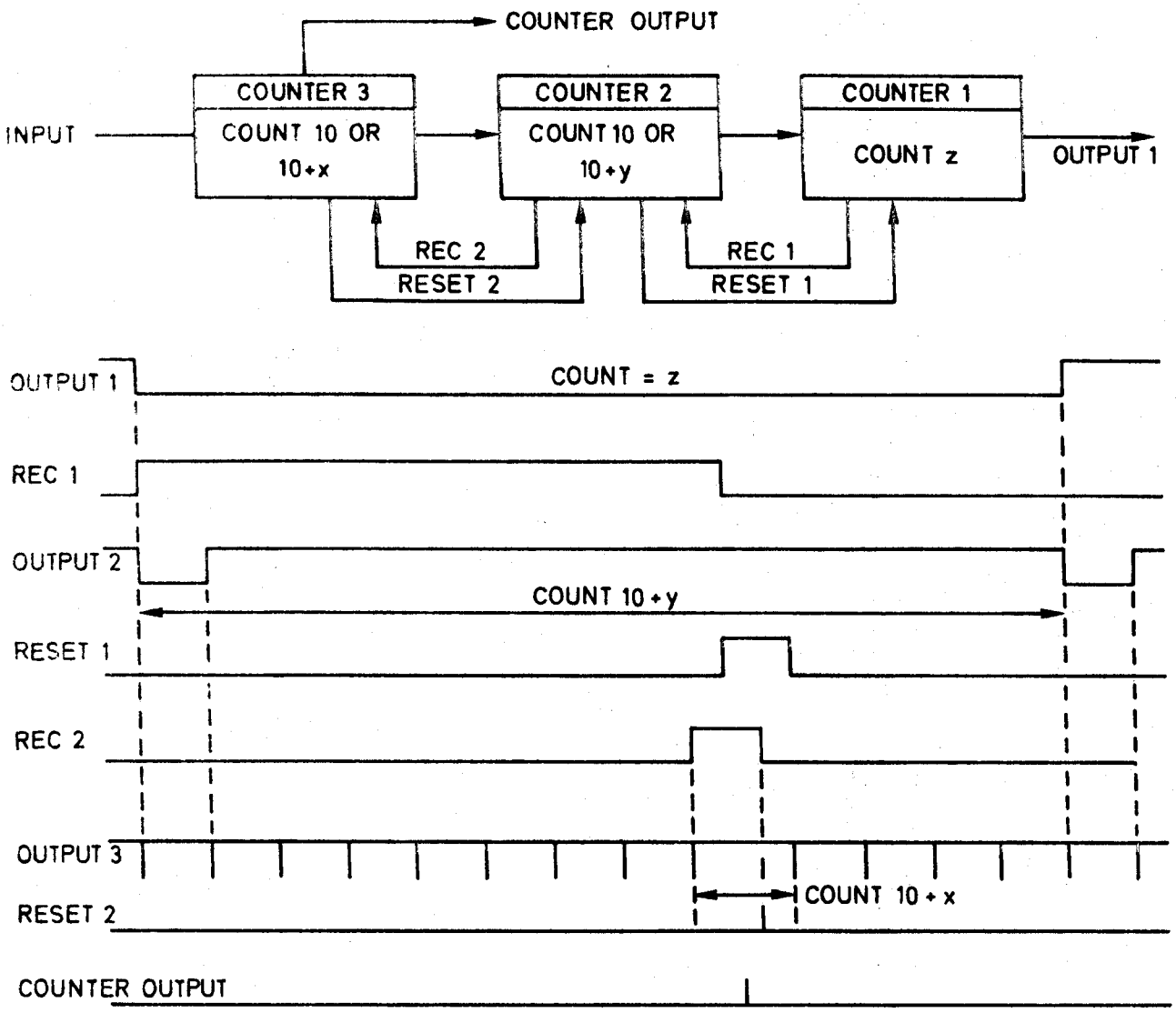


Fig.2 Control of extended count period by recognition

12. The divider circuit can be extended by additional counter elements. Fig.3 shows a block diagram of the variable divider in Unit 9b; this four-element counter can be shown to have a division factor expressed by:

$$1000z + 100y + 10x + w$$

13. The variables are selected by binary coded inputs to the counter elements from decade switches. For ease of cross reference, Fig.3 shows the actual designations of the switches used and Table 1 gives the values of w, x, y and z for each switch setting. By referring to the figures for minimum and maximum switch settings, and substituting in the above expression, it can be seen that the division factor can be varied from 1750 to 31749.

14. Operational considerations limit the minimum acceptable p.r.f. of the divider output pulses. A finer degree of control is exercised without lowering the p.r.f. by a technique termed programmed sidestep. With reference to figure 3, a waveform generator, operated by counter 1 REC output pulses, produces a waveform that switches the value of factor w between the selected value and the selected value +1 for a number 'v' (see Table 1) of complete count cycles in every ten. For example, if the value of overall count is

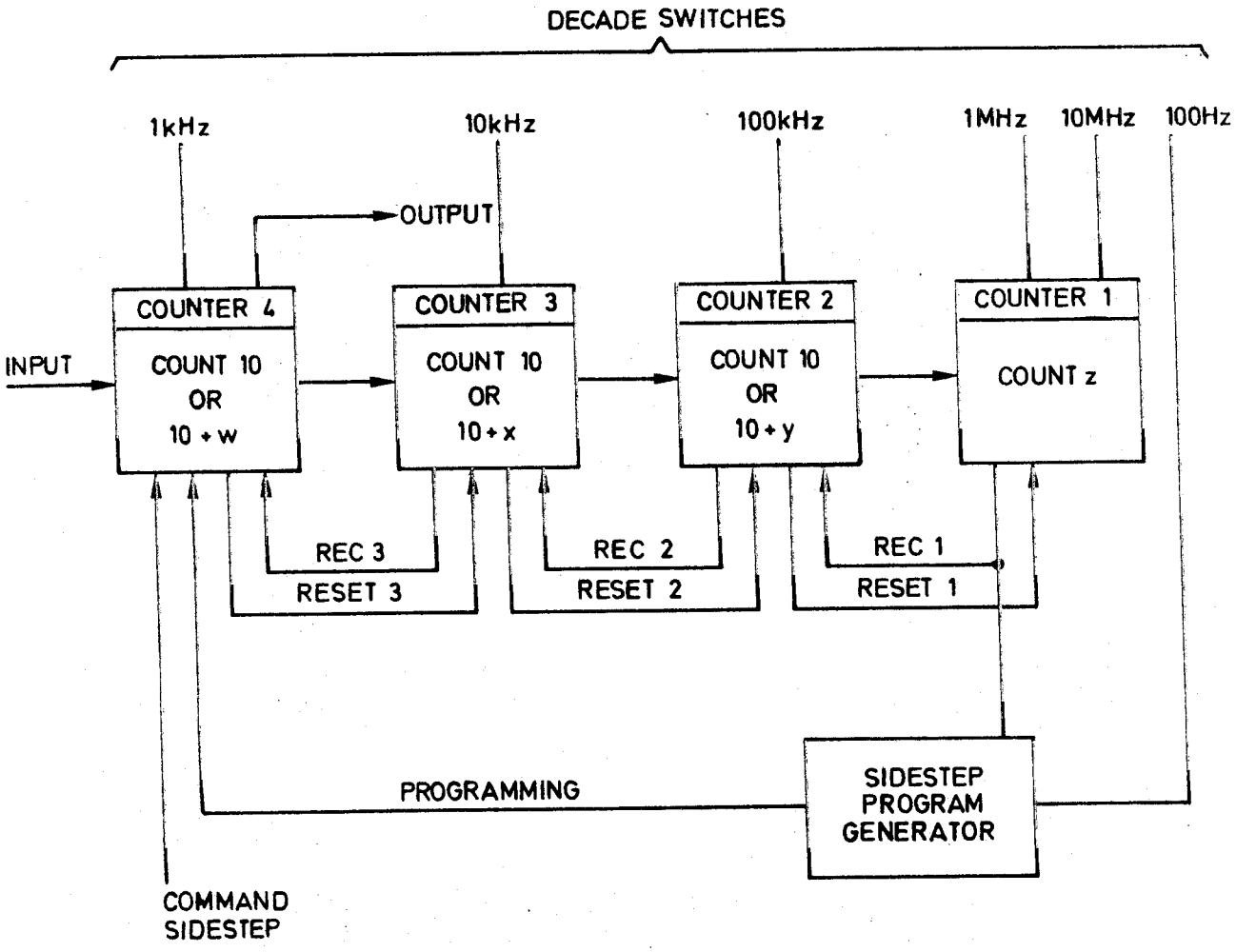


Fig.3 Unit 9b variable divider - simplified

Table 1

Value of count terms

Term	Switch	Value of term for switch setting 0 1 2 3 4 5 6 7 8 9
z	1 MHz (10 MHz @ 0)	2 3 4 5 6 7 8 9 10 11
	1 MHz (10 MHz @ 1)	12 13 14 15 16 17 18 19 20 21
	1 MHz (10MHz @ 2)	22 23 24 25 26 27 28 29 30 31
y	100 kHz	-2 -1 0 1 2 3 4 5 6 7
x	10 kHz	-5 -4 -3 -2 -1 0 1 2 3 4
w	1 kHz (ignoring sidestep)	0 1 2 3 4 5 6 7 8 9
v	100 Hz	0 1 2 3 4 5 6 7 8 9

switched from 2325 to 2326 for 3 count cycles in every 10, the average division factor would be:

$$0.1\ (7 \times 2325) + (3 \times 2336) = 2325.3$$

i.e. the division factor is increased by 0.1V.

15. To meet a requirement that the VFO frequency should be reduced from the selected value, without change in frequency switch setting, a sidestep command is applied to counter 1 on certain operating modes of the transmitter receiver. This command is a switched d.c.; when the d.c. is present, the counter operates in the manner described above and when the d.c. is removed, the selected value 'w' is effectively reduced by 2 (i.e. the division factor is reduced by 2).

NOTES: 1. In normal operation the VFO output frequency is adjusted to hold the counter output constant at 250 Hz. Thus, in the simplest terms, it is the input to the divider that is variable - not the output.

2. The switch settings are marked for transmitter/receiver operating frequency and do not relate to frequencies within the synthesiser.

Unit 9a (see Fig.5)

16. HF from the VFO, at approx. 1.4V peak-peak, is applied via buffer amplifier ML1 to a divide-by-four circuit in ML2. A rectangular waveform of about 0.7V peak-peak and 1/4 the input frequency is produced by ML2 for supply to the variable divider in Unit 9b.

Unit 9b (see Fig.6)

17. Unit 9b contains two divider chains, one fixed and one variable.

18. The fixed divider is provided by ML1 (÷5), ML2 (÷5) and ML3 (÷7). The input to ML1 is a 1.75 MHz rectangular waveform from an external reference oscillator, it is divided by 175 to provide a 10 kHz rectangular waveform for supply to Unit 9c.

19. The variable divider is provided by ML4 to ML8 inc. The overall division factor is determined by binary coded signals from external decade switches (refer to Table 2).

20. The operation of the variable divider is essentially as described in paras.6 to 15. Particular points of additional detail are as follows:

(1) Each of ML4 to ML7 is clocked by the negative going edge of the input to pin 8 of the element.

(2) CARRY output pulses from ML4, ML5, ML6 are negative going. All other output pulses are positive going.

(3) Refer to Table 3 for details of ML8 operation.

(4) ML4 CARRY output pulse width is twice the period of its clock input. ML5 and ML6 CARRY output pulse width is equal to the period of the respective clock input.

(5) Each REC output pulse is initiated by the negative going edge of the respective element's clock input and terminated by the positive going edge of the respective RESET input.

Table 2

Frequency setting switch code

Unit 9/9b Pin	Signals applied in Switch Position										Switch
	0	1	2	3	4	5	6	7	8	9	
9	+	0	+								10MHz
23	0	+	+								
25	0	+	0	+	0	+	0	+	0	+	1MHz
24	0	0	0	0	+	+	0	0	+	+	
7	0	0	0	0	0	0	+	+	+	+	
8	0	0	+	+	+	+	+	+	+	+	
28	+	0	+	0	+	0	+	0	+	0	100kHz
27	0	+	+	0	0	0	0	+	+	0	
5	+	+	+	0	0	0	0	0	0	+	
6	+	+	+	0	0	+	+	+	+	+	
26	0	0	+	+	+	+	+	+	+	+	
31	0	+	0	+	0	+	0	+	0	+	10kHz
30	+	+	0	0	+	+	0	0	0	0	
3	0	0	+	+	+	+	0	0	0	0	
4	+	+	+	+	+	+	0	0	+	+	
29	0	0	0	0	0	+	+	+	+	+	
33	+	0	+	0	+	0	+	0	+	0	1kHz
32	+	0	0	0	0	+	+	0	0	+	
37	+	0	0	0	0	0	0	+	+	+	
1	+	0	0	+	+	+	+	+	+	+	
22	0	+	0	+	0	+	0	+	0	+	100Hz
10	0	+	+	+	+	0	+	+	+	+	
12	+	0	0	+	+	+	+	+	0	0	
21	0	+	+	+	0	0	+	0	0	0	
11	0	+	+	+	+	+	+	+	+	+	
2	+ (Zero sidestep) 0 (-2kHz sidestep)										

+ indicates +3V nominal
0 indicates open circuit

Table 3

Sidestep programming generator

Completes one cycle for every 10 input pulses. Output waveform change initiated by negative going edge of ML7 REC output.

100 Hz switch setting	Output sequence									
	1	2	3	4	5	6	7	8	9	10
0	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	0
2	1	1	1	1	0	1	1	1	1	0
3	1	1	1	0	1	1	1	0	1	0
4	0	0	1	1	1	0	0	1	1	1
5	0	1	0	1	0	1	0	1	0	1
6	1	1	0	0	0	1	1	0	0	0
7	0	0	0	1	0	0	0	1	0	1
8	0	0	0	0	1	0	0	0	0	1
9	0	0	0	0	0	0	0	0	0	1

Logic 1 = +3V
Logic 0 = 0V
Division factor increased by 1 when output is logic 0.
Average division factor increased by 0.1 x 100 Hz switch setting.

(6) Each RESET pulse occurs slightly before the respective element produces a CARRY pulse during an extended count.

(7) During the extended count at ML5 and ML6, two CARRY pulses are produced if, and only if, the value of the term "x" or "y" (Table 1) as appropriate, is negative.

Unit 9c; Reference Divider and Comparator (Fig.7)

21. The 10 kHz square-wave derived by Unit 9b from the reference oscillator output is applied to a divider formed by ML1 and ML2. The output from pin 7 of ML1 is at 2 kHz, while the output from pin 6 of ML2 is at 250 Hz: both are rectangular waveforms.

22. ML3 contains two monostables, the pulse durations of which are set at approx. 30 usec by C2, C3, R2, R3. The two are termed 'ramp mono', and 'sample mono'. The 'ramp mono' is triggered by the output from the variable divider in Unit 9b, while the 'sample mono' is triggered by the 250 Hz 'reference' output from pin 6 of ML2.

23. Frequency comparator ML4 compares the phase and frequency of the outputs from the two monostables in ML3. The device contains two comparator circuits; one produces an output from pin 2 when the frequency of the 'ramp mono' output is greater than that of the 'sample mono', while the other produces an output from pin 9 when the frequency of the 'ramp mono' output is less than that of the 'sample mono'. The outputs are only produced when the difference between the two frequencies is greater than 1 Hz, and consist of a pulse train at the difference frequency between the two inputs. When both inputs are within 1 Hz output levels set to logic '0', and the output from ML4 pin 8 changes from '0'

to '1'. This produces the 'PHASE LOCK' output at edge pin 6 by turning on TR2. A time constant is provided in TR2 base circuit to prevent outputs being obtained during very short periods of frequency coincidence.

24. The PHASE ANGLE output from ML4 pin 1 sets to '1' on receipt of a 0-1 transition on pin 5, and to '0' on receipt of a 1-0 transition on pin 6. The output from pin 1 is therefore a rectangular waveform with a mark-space ratio proportional to the phase relationship between the outputs from the two monostables.

25. ML5 is a four stage (count of sixteen) up/down counter which is clocked from 0 to 15 by the output from ML4 pin 2, and from 15 to 0 by the output from ML4 pin 9. The Q2 (B), Q3 (C) and Q4 (D) outputs are applied to a decoder in Unit 9d which controls an attenuator.

26. Since only one clock pulse is required to move the count of ML5 from 0 to 15 or from 15 to 0, the attenuation level produced by the circuits in Unit 9d could suddenly change from maximum to minimum or vice versa, completely disrupting the tuning process. To prevent this, outputs from Unit 9d which occur at counts 0 or 1 and 14 or 15 are applied to ML4 pins 11 and 4; these inputs, together with the Q1 (A) and $\overline{Q1}$ ($\bar{A}$) outputs from ML5, inhibit the output from ML4 pin 2 when count 15 is reached and inhibit the output from ML4 pin 9 when count 0 is reached.

Unit 9d; Programmed Variable Attenuator (Fig.8)

27. Unit 9d contains one element of a switched attenuator, the remainder of which is contained in Unit 9e. The element of the attenuator in Unit 9d can be varied; any one of resistors R1 to R7 can be connected from TR9 base to earth by means of a logic '1' output from ML1 applied to the base of one of transistors TR1 to TR7.

28. ML1 decodes the three most significant bits of the four-bit parallel binary output count from ML5 in Unit 9c, in accordance with Table 4.

Table 4

ML1 action

Unit 9c					Unit 9d							
ML5	ML5 outputs				Outputs at ML1 pins							
Count	A	B	C	D	8	7	6	5	14	1	2	3
0	0	0	0	0	1	0	0	0	0	0	0	0
1	1	0	0	0	1	0	0	0	0	0	0	0
2	0	1	0	0	0	1	0	0	0	0	0	0
3	1	1	0	0	0	1	0	0	0	0	0	0
4	0	0	1	0	0	0	1	0	0	0	0	0
5	1	0	1	0	0	0	1	0	0	0	0	0
6	0	1	1	0	0	0	0	1	0	0	0	0
7	1	1	1	0	0	0	0	1	0	0	0	0
8	0	0	0	1	0	0	0	0	1	0	0	0
9	1	0	0	1	0	0	0	0	1	0	0	0
10	0	1	0	1	0	0	0	0	0	1	0	0
11	1	1	0	1	0	0	0	0	0	1	0	0
12	0	0	1	1	0	0	0	0	0	0	1	0
13	1	0	1	1	0	0	0	0	0	0	1	0
14	0	1	1	1	0	0	0	0	0	0	0	1
15	1	1	1	1	0	0	0	0	0	0	0	1

29. Table 4 shows that counts 0 and 1 from ML5 (Unit 9c) produce logic 1 at 'LIMIT STATE' output from pin 8, while counts 14 and 15 produce logic 1 at 'LIMIT STATE' output from pin 3. Counts 2 to 15 switch on one transistor, so connecting one resistor of R1 to R7 from TR9 base to earth. The attenuation effect produced can only be seen in conjunction with effect of the least signficant bit 'A' output from ML5 (Unit 9c) on the portion of the attenuator in Unit 9e. When the least significant bit of ML5 (Unit 9c) output is '1', the 'PHASE' output from pin 10 of Unit 9e is reduced in amplitude. For the purpose of explanation, it is assumed that the output from pin 10 of Unit 9e is of voltage V, and drops to 0.8V when the LSB output from ML5 (Unit 9c) is '1'; it is further assumed that the impedance is 50k ohm. Under these conditions, the effect of connecting one resistor from R1 to R7 in series with this output is to produce the attenuations shown in Table 5. Attenuation increases with the value of the count output from ML5 (Unit 9c).

Table 5

Attenuation levels

ML5 Count	'PHASE' input	Resistor connected	Voltage to TR9
0	V	NONE	V
1	.8V	NONE	.8V
2	V	R1	.69V
3	.8V	R1	.55V
4	V	R2	.48V
5	.8V	R2	.38V
6	V	R3	.34V
7	.8V	R3	.27V
8	V	R4	.24V
9	.8V	R4	.19V
10	V	R5	.17V
11	.8V	R5	.13V
12	V	R6	.12V
13	.8V	R6	.10V
14	V	R7	.09V
15	.8V	R7	.07V

Unit 9e; Sample and Hold Circuit (Fig.9)

30. Unit 9e contains a 'sample and hold' circuit followed by one section of a switched attenuator, the remainder of which is situated in Unit 9d. The 'sample' level can be raised or lowered from the value of 'RAMP' input sampled; this is used to provide a coarse tuning facility.

31. Storage capacitor C1 is either charged via TR1 or discharged via TR4 for an approx. 30 uS period in each 4 mS Ramp period, when the 'SAMPLE MONO' output pulse is applied to TR2 and TR3. A 'SAMPLE MONO' input pulse causes TR1 and TR4 to conduct simultaneously. If the voltage across C1 at this moment is less than the voltage of the 'RAMP' sample, C1 charges via TR1; if the voltage across C1 is greater than the voltage of the 'RAMP' sample, TR1 cannot conduct and C1 discharges via TR4. Successive sampling pulses cause C1 to be charged to a mean dc level with a small superimposed ripple.

32. Provided that neither TR6 nor TR7 are conducting, which is the case when the loop has 'captured' the oscillator, the potential developed across C1 will be that portion of the ramp sampled by TR1 and will be a function of the difference in phase between the ramp and sample monostable outputs. If however,

the slave oscillator frequency is so high or low as to cause comparator ML4 in Unit 9c to produce a 'GATED SLAVE FREQ' output (para.23), then C1 potential is varied by either TR7 or TR6.

33. If a 'GATED SLAVE FREQ. LOW' input is present, then a series of 0-1-0 pulses is applied to TR5 base; for the duration of each pulse, TR5 conducts and connects R9 as a 27k ohm discharge path across C1. If a 'GATED SLAVE FREQ. HIGH' input is present, then a series of 0-1-0 pulses is applied to TR6 base; for the duration of each, TR7 acts as a current source and increases the charge in C1.

34. The sample voltage across C1 is taken via Darlington pair emitter-follower TR8, TR9, R13. Due to the very high gain of this circuit, an extremely high resistance discharge path is produced; ripple on the voltage across R13 is only of the order of a few millivolts.

35. The output from TR9 emitter is applied to a switched attenuator formed by R14, R16 and TR10. When the 'A' (LSB) output from ML5 in Unit 9c is '1', TR10 conducts; R14 and R16 then act as an attenuator between TR9 emitter and TR10 base. The potential at R14-R16 junction is applied to Darlington pair emitter-follower TR11-TR12 to provide the 'PHASE' output to the attenuator in Unit 9d.

NOTE: When there is loss of lock, the effect of fast pull-up (TR6/7) or fast pull-down (TR5) combined with attenuator switching in steps, results in the synthesiser producing a rapidly changing mean output with a small sawtooth superimposed.

Unit 9f; Ramp Generator (Fig.10)

36. Unit 9f contains an exponential ramp generator, and an RF filter producing the +105V supply to Unit 9e.

37. TR1 and TR2 are non-conducting except for approx. 30 uS every 4 mS, when the 'RAMP MONO' input 0-1-0 pulse is applied from Unit 9e. During the 4 mS before the application of the 'RAMP MONO' pulse, C1 will have discharged via R6, and TR2 emitter potential will be no lower than the clamp voltage of approximately +55V set by R7, R8 and D1. A typical practical value is +75V.

38. On application of a 'RAMP MONO' pulse, TR1 and TR2 conduct: C2 rapidly charges to approximately +98V from C1. On termination of the 'RAMP MONO' pulse, C2 discharges exponentially via R6 until the application of the next 'RAMP MONO' pulse. The waveform produced is applied to Darlington pair emitter-follower TR3-TR4-R10 to produce the 'RAMP' output to Unit 9e.

39. The 105V supply to Unit 9e is produced by R9 and C3 from 110V supply input to Unit 9f.

TESTING

40. Before Unit 9 can be passed as serviceable, it must satisfy all the relevant tests. Appropriate procedures and related information are given in Part 4 of this manual.

FAULT FINDING

41. The information given in Table 6 is intended to aid diagnosis of the location of a fault; it provides the nominal waveform at various points when the synthesiser is connected to a VFO and reference oscillator as specified for the relevant test configuration in Part 4.

Table 6

Typical signal levels

Unit	Pin	Function	Pulse width	Typical Amplitude	Remarks
9a	38	RF input		1.4V p-p	3.748 MHz - 31.7499 MHz
9b	45	Clock	Variable	0.7V p-p	937 kHz - 8 MHz
9b	8	Ref input	Mark space 2.2:1 to 1.2:2	1.1V to 3V p-p	1.75 MHz
9b	41	Count output	125 ns to 1.1 us	1.1V p-p	250 Hz prf nominal
9b	40	10 kHz output	Mark space 4:3	1.1V p-p	
9c	5	2 kHz output	Mark space 2:3	11.5V p-p	
9c	6	Phase lock	dc dc	0-400 mV* 11.5V*	In lock Out of lock
9c	11	Phase angle output	Variable	7.5V p-p	If output connected via 8K to +8V supply.
9c	12	Ramp mono	30 us	1.1V p-p	250 Hz prf nominal
9c	3	Sample mono	30 us	1.1V p-p	250 Hz prf nominal
9c 9c 9c 9c	1 2 17 18	(Counter D (Counter C (Counter B (Counter A (	Variable	1.0V p-p	To see these waveforms the synthesiser must be out of lock with pins 4 and 15 of Unit 9c disconnected.
9d	12	Limit state	dc	1.0V	VFO at range 1 & 3.1 MHz selected.
9d	2	Limit state	dc	1.0V	VFO at range 2 & 3.1 MHz selected.
9c	8	Range control	dc	6 to 88V	Level depends on channel frequency selected.
9f	2	Ramp output	4 ms	22V p-p	4 ms period if phase lock (Sweep from +98V to +75V approx.).
9e	10	Phase output	dc	50-102V	Level depends on channel frequency selected.

* When output connected via 12K to +12V supply

42. Due to the very wide difference in p.r.f. within the synthesiser, it is suggested that, for all circuits other than the dividers the leading edge of the pulse input to a circuit be used to synchronise the oscilloscope when checking any point within that circuit. For fixed divider elements, use the element's output pulse for synchronisation and check that the appropriate number of input pulses occur for each cycle of output by comparing the input and output on a double beam oscilloscope. For the variable divider elements, it is impracticable to display a full cycle of operation, it is best to proceed as follows:

(a) For ML4, ML5 and ML6, synchronise the oscilloscope to the positive going edge of the REC input to the element and check each output. Particularly check that the time of the CARRY output pulses (w.r.t. trigger) increases with each step of the associated frequency switch from 0 to 9.

(b) For ML7, synchronise the oscilloscope to the negative going edge of its REC output and check that the time of the positive going edge of this output (w.r.t. trigger) increases with each step of the 1 MHz/10 MHz switches from 2 MHz to 29 MHz.

(c) For ML8, use self sync. and check that the pattern from ML8 pin 7 corresponds to the 100 Hz switch setting as given in Table 3.

NOTE: A fault condition could give rise to incorrect signal conditions at points before the actual location of the fault within the loop containing the synthesiser. Do not attempt to locate the faulty pec by indiscriminate change of pec because damage can result from excessive soldering/unsoldering.

REPAIR POLICY

43. It is recommended that repair of the synthesiser at third line be limited to replacement of faulty pec. Replacement of component parts on pec should be carried out only if locally authorised.

44. Following repair and assembly, the tests given in this section must be carried out in full.

45. A faulty unit returned to third line for repair should have the cover removed and be subjected to the test given in this section. If an incorrect result is obtained, maintain the test conditions and, with the aid of the data given in para.41, 42 attempt to diagnose which pec is at fault and then locate the fault within the pec.

ASSEMBLY/DISASSEMBLY

NOTE: Refer to Fig.13 for component location and to Fig.12 for interconnecting wire link data.

Cover

46. To remove the cover, proceed as follows:

(1) Remove the four nuts and washers securing the cover.

(2) Remove the fixing bracket (if still fitted after removal of Unit 9 from Unit 1).

(3) Remove the cover.

(4) Discard the exposed gasket.

47. To replace the cover, fit a new gasket (para.43), fit the cover and fixing bracket (if available). Secure with the four nuts and washers, tightening the nuts to a torque of 2.25 ± 0.25 lb. inches.

48. To fit a new gasket, it is necessary to trim the replacement to the required length - the join should be positioned approx. midway along any one side and the ends sealed using a silicone rubber sealant approx. 0.25 in. either side of joint.

Units 9c to 9f

NOTE: All orientation given below assumes that the synthesiser is positioned with its base lower most. The component sides of the pec are then:

Units 9d and 9f - component side facing down.
Units 9e and 9c - component side facing up.

49. To replace any one of Units 9c, 9d, 9e or 9f, proceed as follows:

(1) Remove the cover (para.46).

(2) Locate and unsolder the wire links connected to the edge slots of the unit to be replaced. Any link that provides a through connection should also be unsoldered at all units above, or all units below, whichever involves the fewest edge slots.

(3) If removing Unit 9c, unsolder the fixed pin from terminal 22 on Unit 9c.

(4) At the top of the synthesiser, remove the four nuts and washers from the studs which pass through the spacer pillars of all units.

(5) Withdraw, as a block, all units above that which is to be replaced.

(6) Remove the unit which is to be replaced.

(7) Position the replacement unit with its pillars over the four fixing studs and with its component side correctly oriented (see note above). In the case of positioning Unit 9c, ensure that the fixed pin locates with, and moves freely into, terminal 22 of the unit.

(8) Position the block of units (withdrawn in (4) above), with their pillars over the four fixing studs.

(9) Secure the units in place with four nuts and washers.

(10) Solder the fixed pin to terminal 22 of Unit 9c (only if this unit replaced).

(11) Solder all wire links disconnected in (2) above. If necessary, renew links using 22 swg tinned copper wire.

(12) Fit the cover (para.47).

Unit 9a

50. To replace Unit 9a, proceed as follows:

(1) Remove the cover (para.46.

(2) At the top of the synthesiser, remove the four nuts and washers from the studs which pass through the spacer pillars on all units.

(3) At the bottom of the synthesiser, withdraw the lower base and the four studs.

(4) The printed circuit side of Unit 9a is now exposed. Unsolder the joints at terminals 1, 2, 3 and 4.

(5) Remove the two screws and washers which secure Unit 9a to the upper base and remove the unit.

(6) Place the replacement Unit 9a in position, ensuring that the fixed pins locate correctly to terminals 1, 2, 3 and 4 on the unit.

(7) Secure Unit 9a in position using two screws and washers.

(8) Solder terminals 1, 2, 3 and 4.

(9) Replace the lower base and the four studs.

(10) Secure the units with four nuts and washers.

(11) Fit the cover (para.47).

Unit 9b and Upper Base

51. Special soldering techniques are employed during construction and no attempt should be made to separate Unit 9b from the upper base or to replace filter connectors on the base. However, discrete components on Unit 9b can be replaced and are accessible after Units 9b - 9f have been removed.

52. To replace Unit 9b/upper base, proceed as follows:

(1) Remove Unit 9b - 9f as a block, employing the procedure given in para.49(1) to (5).

(2) At the bottom of the synthesiser, withdraw the lower base and the four studs.

(3) The replacement upper base assembly is supplied complete with Units 9a and 9b. Fit the lower base and the four studs to this assembly and then fit Units 9b - 9f, employing the procedures given in para.49(7) to (12).

COMPONENTS LIST

53. The principal component parts of the Synthesiser Unit 682/1/00400 are:

Description	Reference
Base, lower	682/2/01777
Base, upper assembly inclusing:-	682/1/00409
Panel, electronic circuit (Unit 9a)	682/1/00450
Panel, electronic circuit (Unit 9b)	682/1/00460
Panel, electronic circuit (Unit 9c)	682/1/00470
Panel, electronic circuit (Unit 9d)	682/1/00480
Panel, electronic circuit (Unit 9e)	682/1/00490
Panel, electronic circuit (Unit 9f)	682/1/00500
Gasket	682/2/00241
Cover	682/2/01776

54. Components list for each of Units 9a to 9f are given in the following paragraphs.

55. The principal component parts of Unit 9a, 682/1/00450 are listed below and the component layout is given on Fig.14.

Cct.Ref.	Description	Reference No.
Resistors		
R1	12k ohm ± 2% 0.25W	403/4/05524/120
R2	39 ohm ± 2% 0.25W	403/4/05521/390
R3	560 ohm ± 2% 0.25W	403/4/05522/560
R4	56k ohm ± 2% 0.25W	403/4/05524/560
Capacitors		
C1 to 6	4.7 nF ± 10% 100V	400/9/20593/470
Inductors		
L1	Inductor R.F., 10 uH ± 10%	406/9/08470/024
Semi-conductor devices		
ML1	Integrated circuit CN295F	446/4/00236
ML2	Integrated circuit CN303F	446/4/00240

56. The principal component parts of Unit 9b, 682/1/00460, are listed below and the component layout is given on Fig.15.

Cct.Ref.	Description	Reference No.
Resistors		
R1	3.3k ohm ± 2% 0.25W	403/4/05523/330
Capacitors		
C1	6.8 nF ± 10% 100V	400/4/20593/680
Inductors		
L1	Inductor R.F., 2.2 uH ± 10%	406/9/08470/016
Semi-conductor devices		
ML1,2,3	Integrated circuit CN333F	446/4/00244
ML4	Integrated circuit CN311F	446/4/00223
ML5,6	Integrated circuit CN317F	446/4/00226
ML7	Integrated circuit CN321F	446/4/00229
ML8	Integrated circuit CN325F	446/4/00230

57. The principal component parts of Unit 9c, 682/1/00470 are listed below and the component layout is given on Fig.16.

Cct.Ref.	Description	Reference No.
Resistors		
R1	1.5k ohm ± 2% 0.25W	403/4/05523/150
R2,3	10k ohm ± 2% 0.25W	403/4/05524/100
R4 to 7	3.3k ohm ± 2% 0.25W	403/4/05523/330
R8	33k ohm ± 2% 0.25W	403/4/05524/330
R9	33 ohm ± 2% 0.25W	403/4/05521/330
Capacitors		
C1	6.8 nF ± 10% 100V	400/4/20593/680
C2,3	4.7 nF ± 10% 100V	400/4/20593/470
C4	22 uF ± 10% 16V electrolytic	402/4/55722/220
Inductors		
L1	Inductor R.F., 4.7 uH	406/9/08470/020
Semi-conductor devices		
TR1,2	Transistor C555	417/4/00496/000
ML1,2	Integrated circuit CN333F	446/4/00244
ML3	Integrated circuit CN309F	446/4/00234
ML4	Integrated circuit CN337F	446/4/00247
ML5	Integrated circuit CN339F	446/4/00232

58. The principal component parts of Unit 9d, 682/1/00480 are listed below and the component layout is given on Fig.17

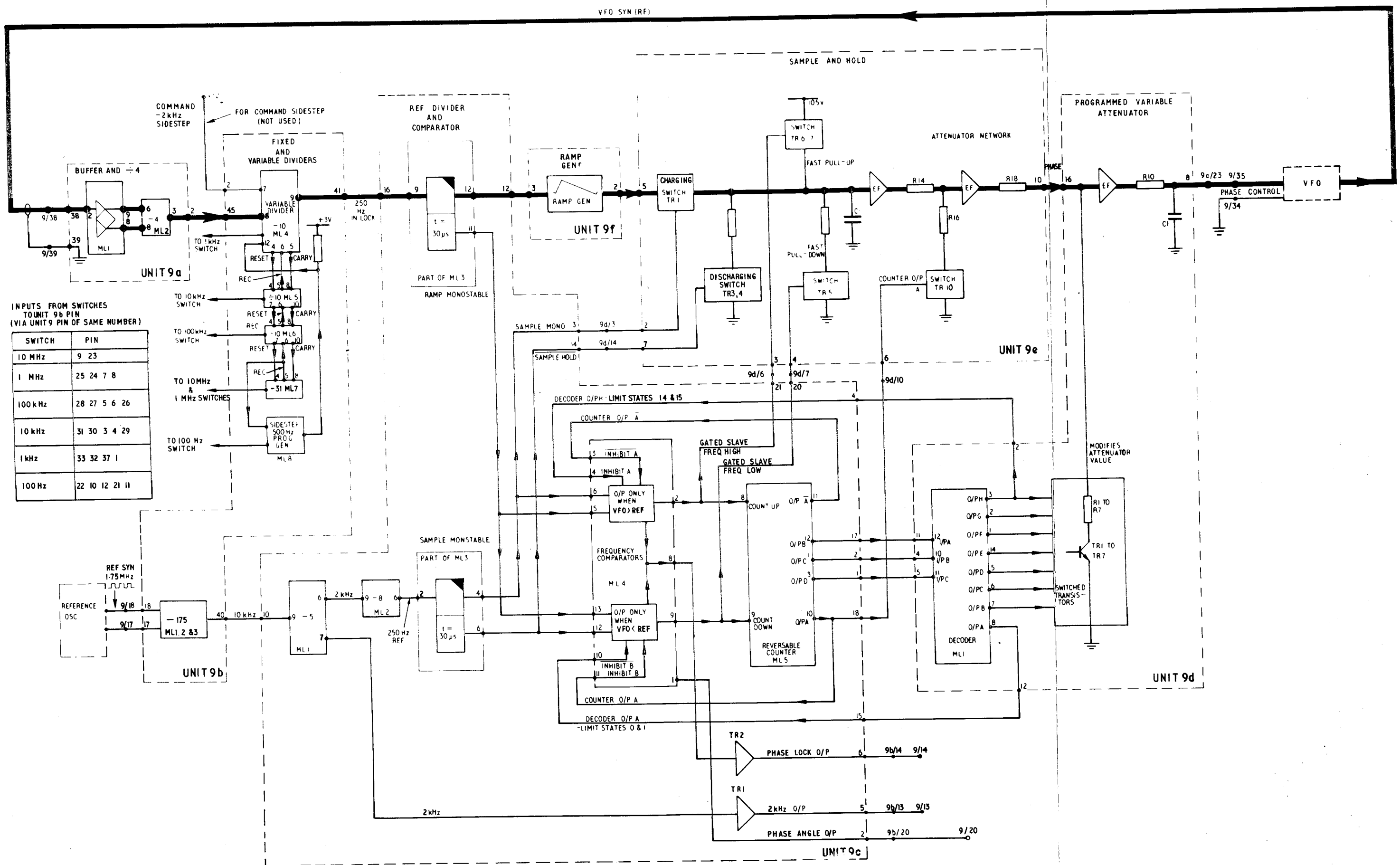
Cct.Ref.	Description	Reference No.
Resistors		
R1	115k ohm ± 1% 0.5W	403/9/03511/008
R2	47.5k ohm ± 1% 0.5W	403/9/03511/007
R3	26.1k ohm ± 1% 0.5W	403/9/03511/005
R4	16k ohm ± 1% 0.5W	403/9/03511/004
R5	10.5k ohm ± 1% 0.5W	403/9/03511/003
R6	6.98k ohm ± 1% 0.5W	403/9/03511/002
R7	4.75k ohm ± 1% 0.5W	403/9/03511/001
R8	680 ohm ± 2% 0.25W	403/4/05522/680
R9	100k ohm ± 2% 0.25W	403/4/05525/100
R10	39k ohm ± 1% 0.25W	403/4/05514/390
Capacitors		
C1	220 nF ± 5% 160V plastic	400/9/18791/028
Semi-conductor devices		
TR1 to 7	Transistor SGS - U14 909/4	417/4/05086
TR8	Transistor SGS - U14 906/4	417/4/05089
TR9	Transistor SGS - U14 908/4	417/4/05087
ML1	Integrated circuit CN341F	446/4/00233

59. The principal component parts of Unit 9e, 682/1/00490 are listed below and the component layout is given on Fig.18

Cct.Ref.	Description	Reference No.
Resistors		
R1	1.5k ohm ± 2% 0.25W	403/4/05523/150
R2	33k ohm ± 2% 0.25W	403/4/05524/330
R3	15k ohm ± 2% 0.25W	403/4/05524/150
R4,5	1.5k ohm ± 2% 0.25W	403/4/05523/150
R6	4.7k ohm ± 2% 0.5W	403/4/05323/470
R7	330 ohm ± 2% 0.5W	403/4/05322/330
R8	1.5k ohm ± 2% 0.25W	403/4/05523/150
R9	27k ohm ± 2% 0.5W	403/4/05324/270
R10	1.5k ohm ± 2% 0.25W	403/4/05523/150
R11	2.2k ohm ± 2% 0.25W	403/4/05523/220
R12	120k ohm ± 2% 0.25W	403/4/05525/120
R13	100k ohm ± 2% 0.25W	403/4/05525/100
R14	47k ohm ± 1% 0.25W	403/4/05514/470
R15	1.5k ohm ± 2% 0.25W	403/4/05523/150
R16	261k ohm ± 1% 0.5W	403/9/03511/009
R17	150k ohm ± 2% 0.25W	403/4/05525/150
R18	47k ohm ± 1% 0.5W	403/9/03511/006
Capacitors		
C1	470 nF ± 5% 160V plastic	400/9/18791/029
Semi-conductor devices		
TR1	Transistor SGS - U14 906/4	417/4/05089
TR2	Transistor SGS - U14 909/4	417/4/05086
TR3	Transistor C555	417/4/00496/000
TR4,5,6	Transistor SGS - U14 909/4	417/4/05086
TR7	Transistor SGS - U14 906/4	417/4/05089
TR8,9	Transistor SGS - U14 908/4	417/4/05087
TR10	Transistor SGS - U14 909/4	417/4/05086
TR11,12	Transistor SGS - U14 908/4	417/4/05087
D1	Diode 1N3070	415/4/05440

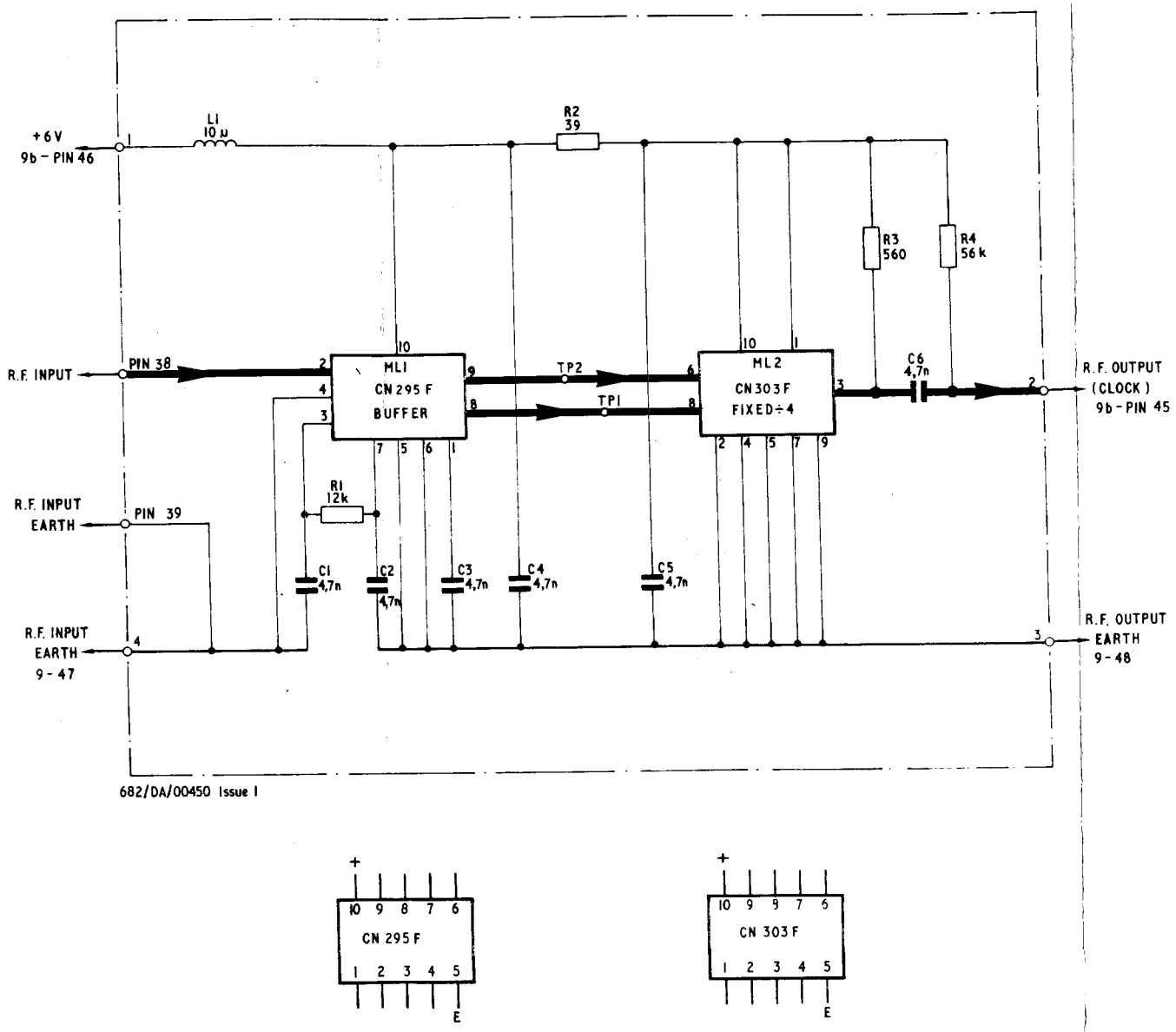
60. The principal component parts of Unit 9f, 682/1/00500 are listed below and the component layout is given on Fig.19

Cct.Ref.	Description	Reference No.
Resistors		
R1	1.5k ohm ± 2% 0.25W	403/4/05523/150
R2	12k ohm ± 1% 0.25W	403/4/05514/120
R3	150k ohm ± 1% 0.25W	403/4/05515/150
R4	2.2k ohm ± 2% 0.25W	403/4/05523/220
R5	27k ohm ± 2% 0.25W	403/4/05524/270
R6	680k ohm ± 1% 0.5W	403/9/03511/012
R7	150k ohm ± 5% 0.25W	403/4/05525/150
R8	220k ohm ± 2% 0.5W	403/4/05325/220
R9	4.7k ohm ± 2% 0.25W	403/4/05523/470
R10	100k ohm ± 2% 0.25W	403/4/05525/100
Capacitors		
C1	9 uF ± 20% 125V electrolytic	402/4/98190/076
C2	22 nF ± 5% 160V plastic	400/9/18791/027
C3	9 uF ± 20% 125V electrolytic	402/4/98190/076
Semi-conductor devices		
TR1	Transistor SGS - U14 909/4	417/4/05086
TR2	Transistor SGS - U14 906/4	417/4/05089
TR3	Transistor SGS - U14 908/4	417/4/05087
TR4	Transistor SGS - U14 907/4	417/4/05088
D1	Diode 1N3070	415/4/05440



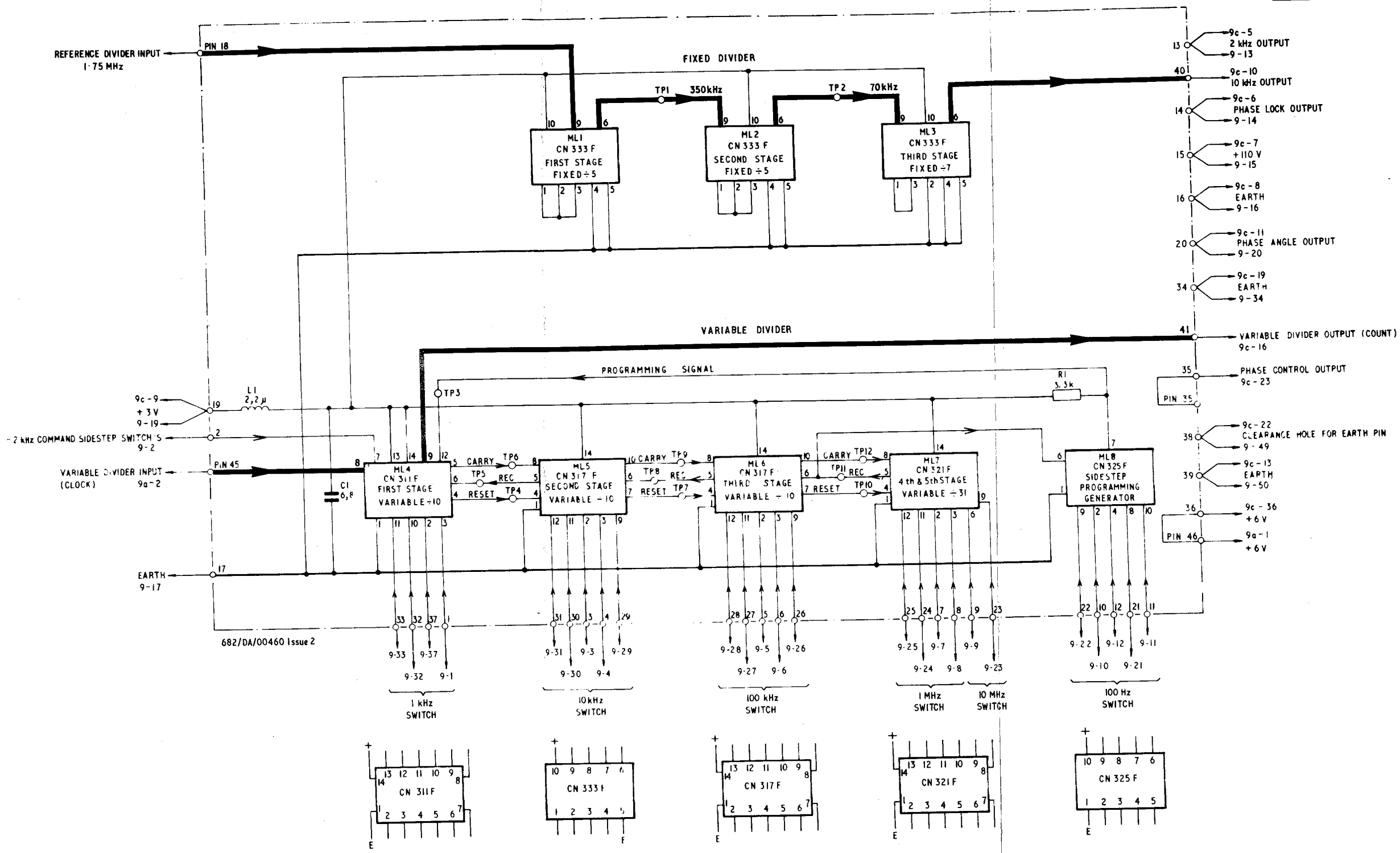
Frequency synthesiser – interconnections and functional block diagram

Fig.4
Issue 3



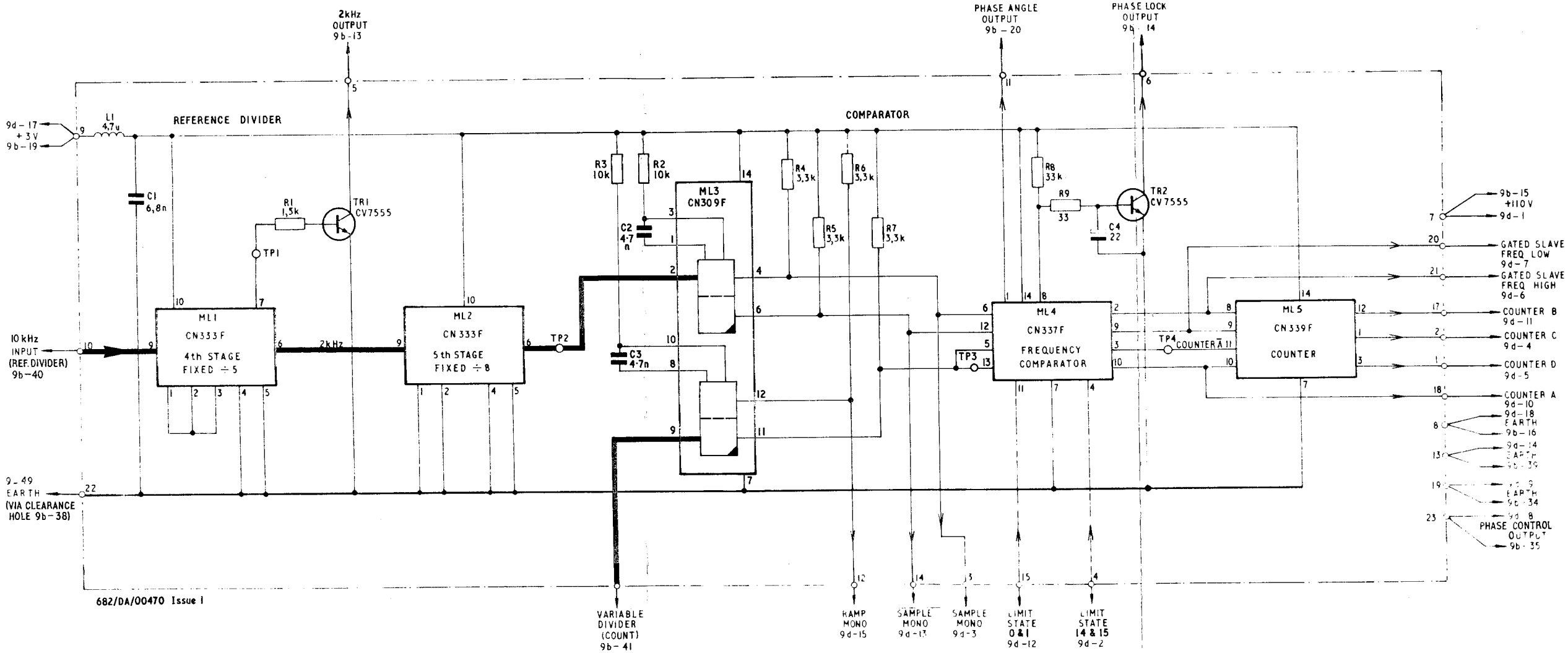
Unit 9a, buffer and divider — circuit

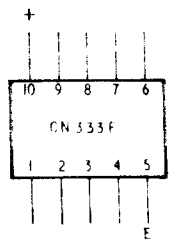
Fig. 5
Issue 3

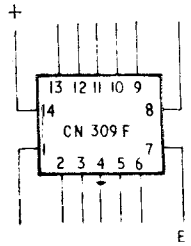

REFERENCE DIVIDER INPUT
1·75 MHz
PIN 18
FIXED DIVIDER
TP1 350kHz
TP2 70kHz
ML1 CN 333 F FIRST STAGE FIXED ÷5
ML2 CN 333 F SECOND STAGE FIXED ÷5
ML3 CN 333 F THIRD STAGE FIXED ÷7
13 9c-5 2 kHz OUTPUT 9-13
40 9c-10 10 kHz OUTPUT
14 9c-6 PHASE LOCK OUTPUT 9-14
15 9c-7 +110 V 9-15
16 9c-8 EARTH 9-16
20 9c-11 PHASE ANGLE OUTPUT 9-20
34 9c-19 EARTH 9-34
VARIABLE DIVIDER
41 VARIABLE DIVIDER OUTPUT (COUNT) 9c-16
PROGRAMMING SIGNAL
TP3
R1 3.3k
35 PHASE CONTROL OUTPUT 9c-23
PIN 35
9c-9 +3V 9-19
L1 2,2 µ
2 kHz COMMAND SIDESTEP SWITCH S 9-2
VARIABLE DIVIDER INPUT (CLOCK) 9a-2
PIN 45
C1 6,8
ML4 CN 311 F FIRST STAGE VARIABLE ÷10
ML5 CN 317 F SECOND STAGE VARIABLE ÷10
ML6 CN 317 F THIRD STAGE VARIABLE ÷10
ML7 CN 321 F 4th & 5th STAGE VARIABLE ÷31
ML8 CN 325 F SIDESTEP PROGRAMMING GENERATOR
CARRY TP6 REC TP5 RESET TP4
CARRY TP9 REC TP8 RESET TP7
CARRY TP12 REC TP11 RESET TP10
38 9c-22 CLEARANCE HOLE FOR EARTH PIN 9-49
39 9c-13 EARTH 9-50
36 9c-36 +6 V
PIN 46 9a-1 +6 V
EARTH 9-17
682/DA/00460 Issue 2
9-33 9-37 9-32 9-1
1 kHz SWITCH
9-31 9-3 9-29 9-30 9-4
10 kHz SWITCH
9-28 9-5 9-26 9-27 9-6
100 kHz SWITCH
9-25 9-7 9-9 9-24 9-8 9-23
1 MHz SWITCH
10 MHz SWITCH
9-22 9-12 9-11 9-10 9-21
100 Hz SWITCH
CN 311 F
CN 333 F
CN 317 F
CN 321 F
CN 325 F

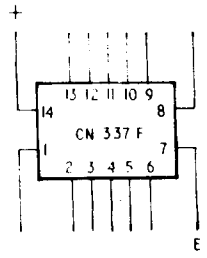
Unit 9b, fixed and variable divider – circuit

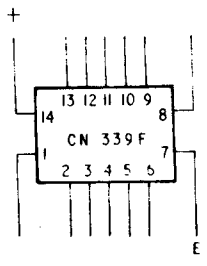
Fig.6
Issue 3



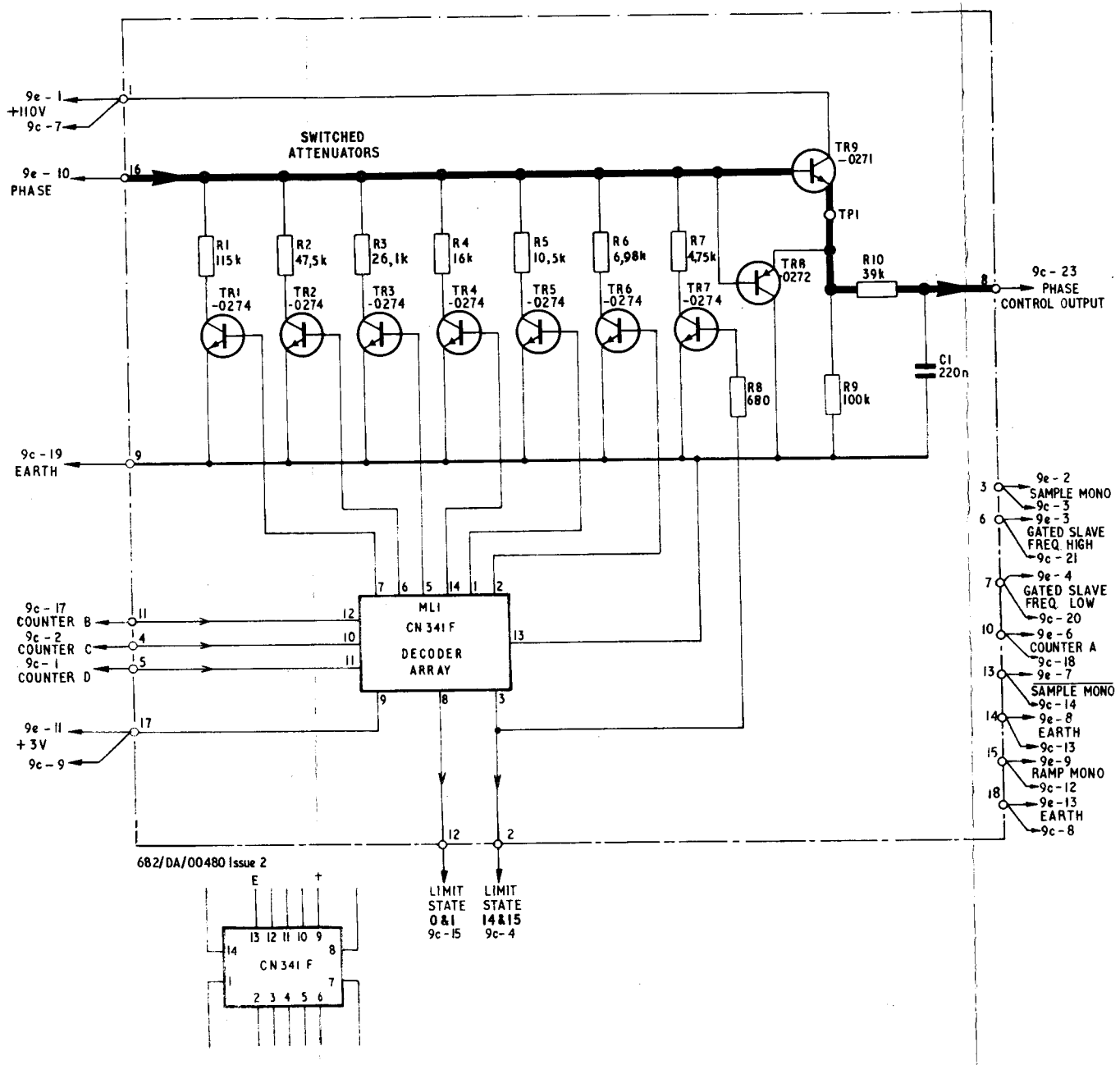








Unit 9c, reference divider and comparator – circuit



Unit 9d, programmed variable attenuator – circuit

Fig.8
Issue 3

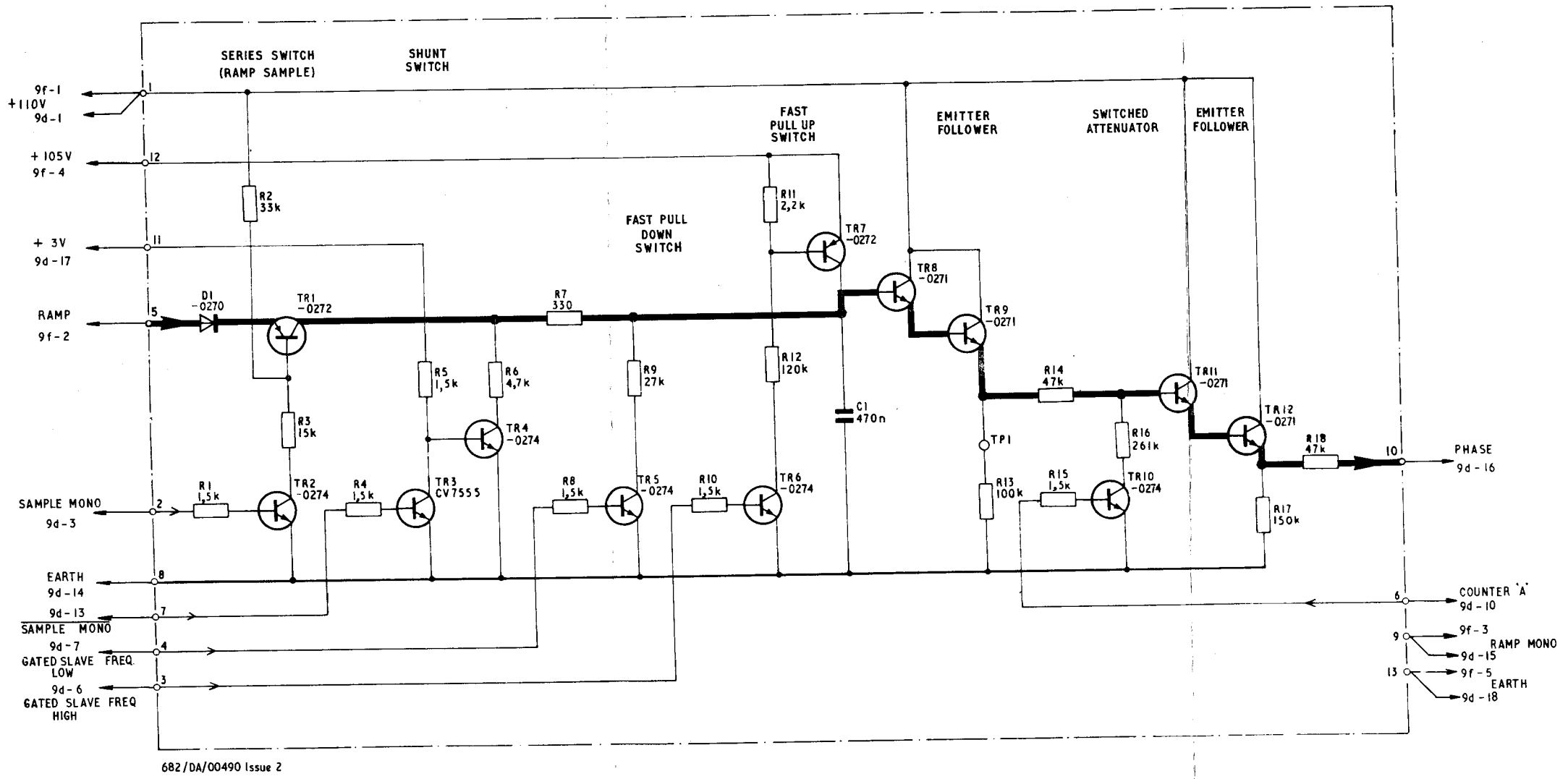


Fig.9
Issue 3

Unit 9e, sample and hold – circuit

Fig.9
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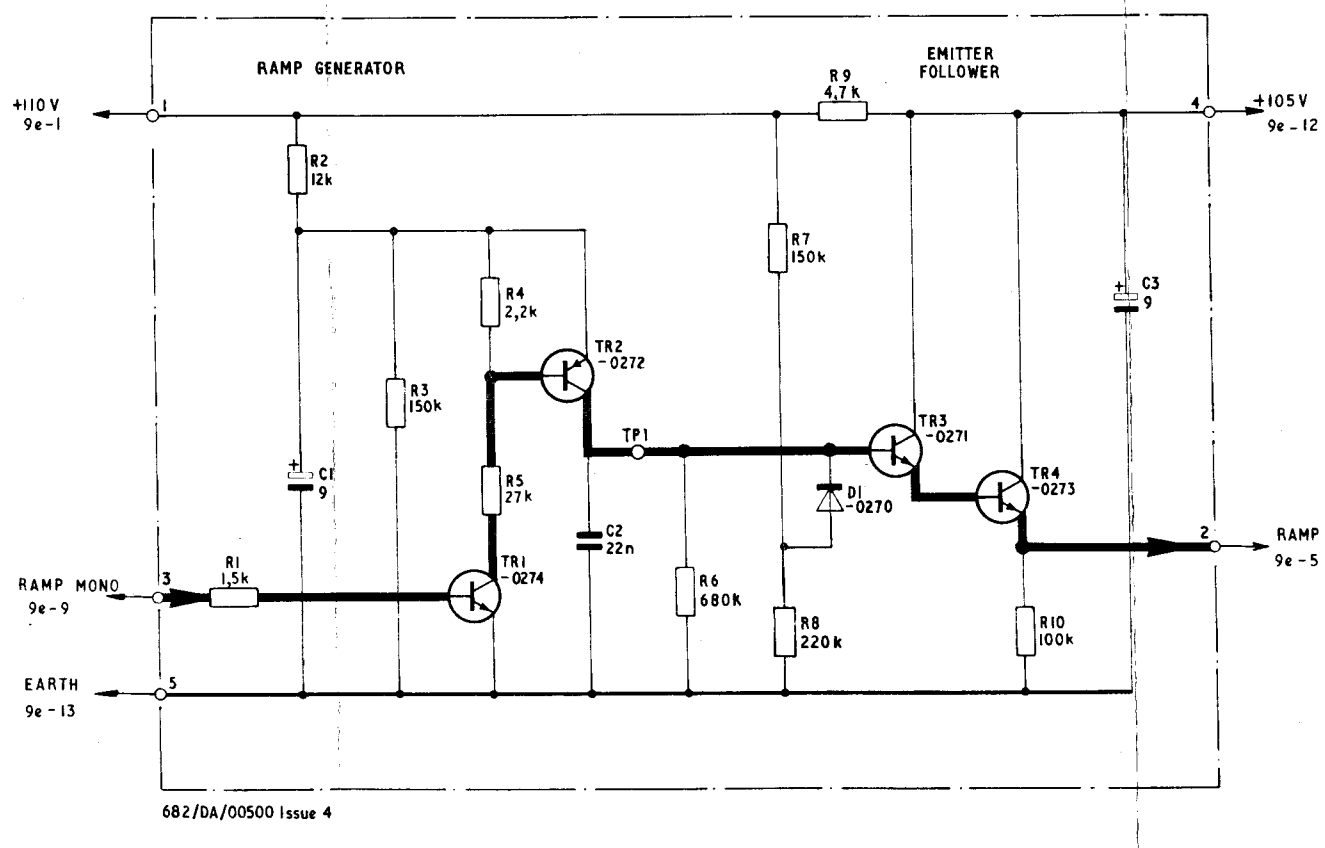

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Fig.10
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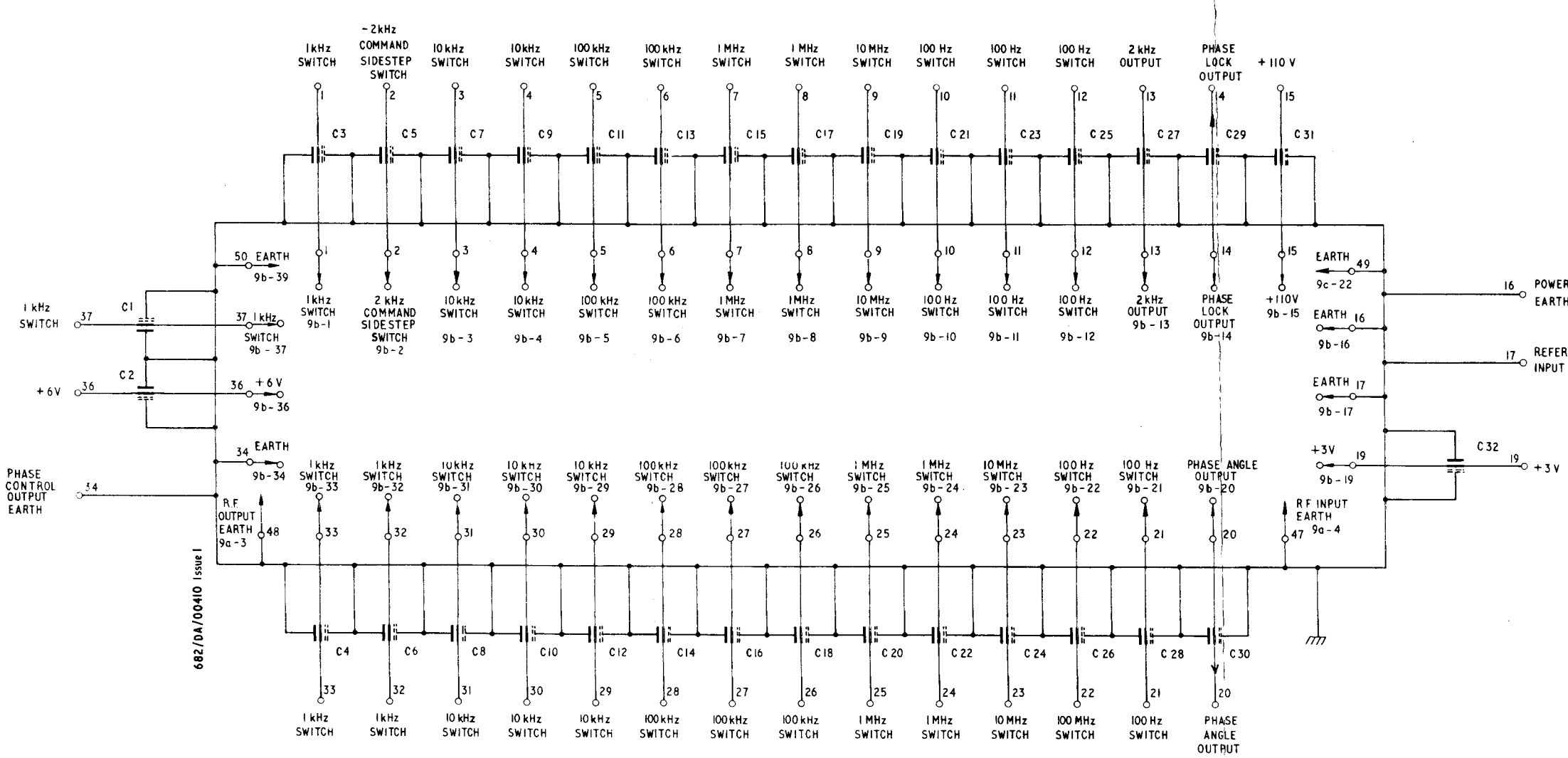
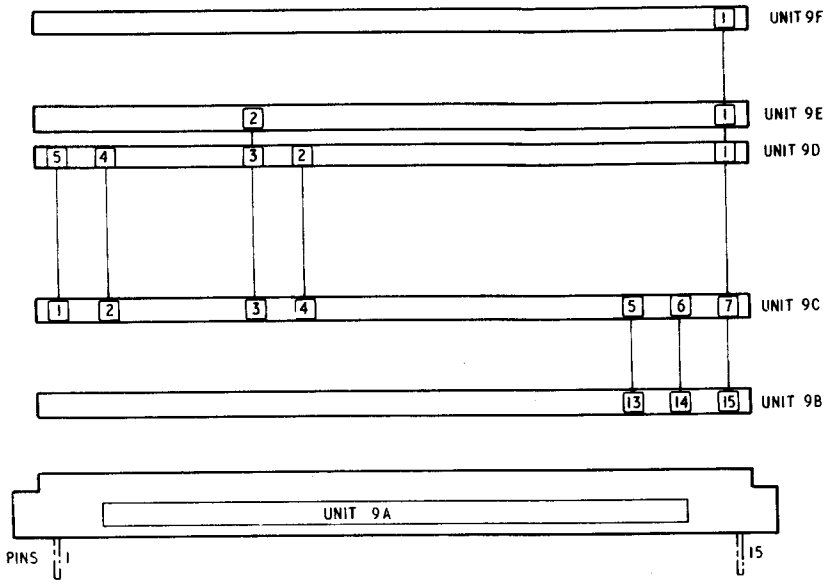
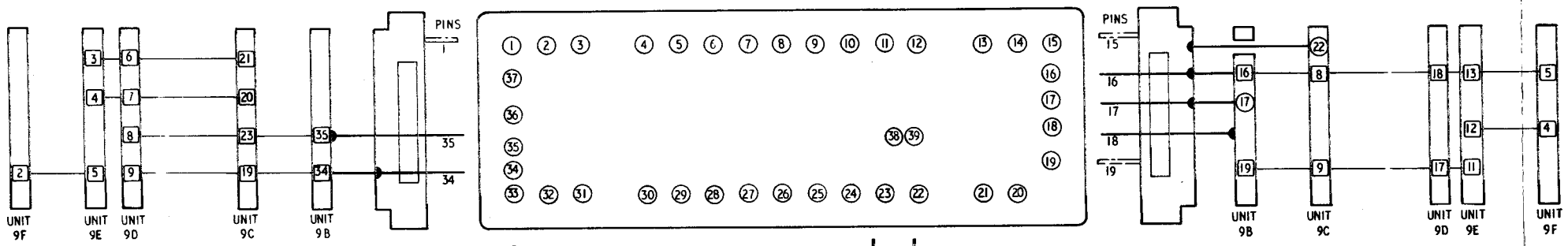
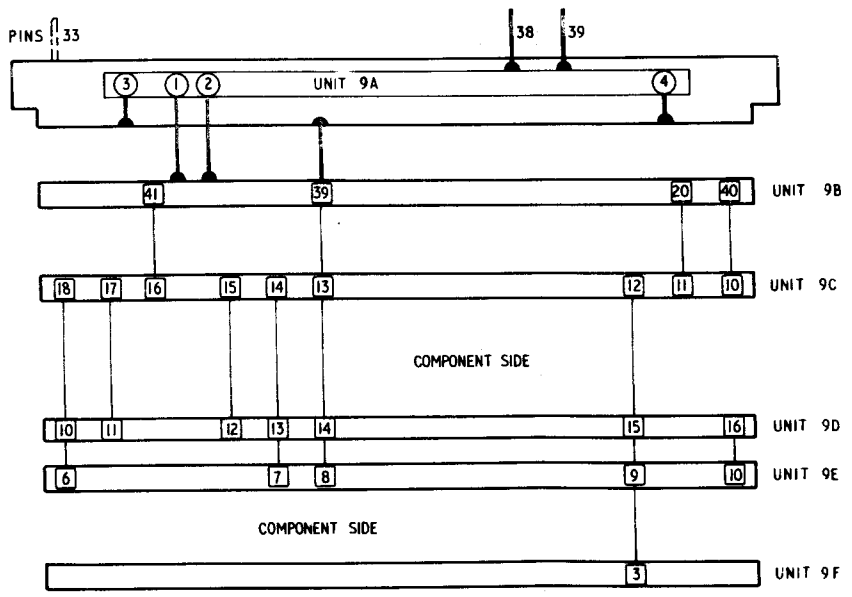
Unit 9f, ramp generator – circuit



Unit 9, synthesiser inputs and connections to internal units







NOTE 1 UNIT EDGE SLOTS ARE SHOWN AND NUMBERED THUS – [2]

2 SOLDER JOINTS WITHIN THE UNIT ARE SHOWN THUS-(2)

Synthesiser wire link - layout

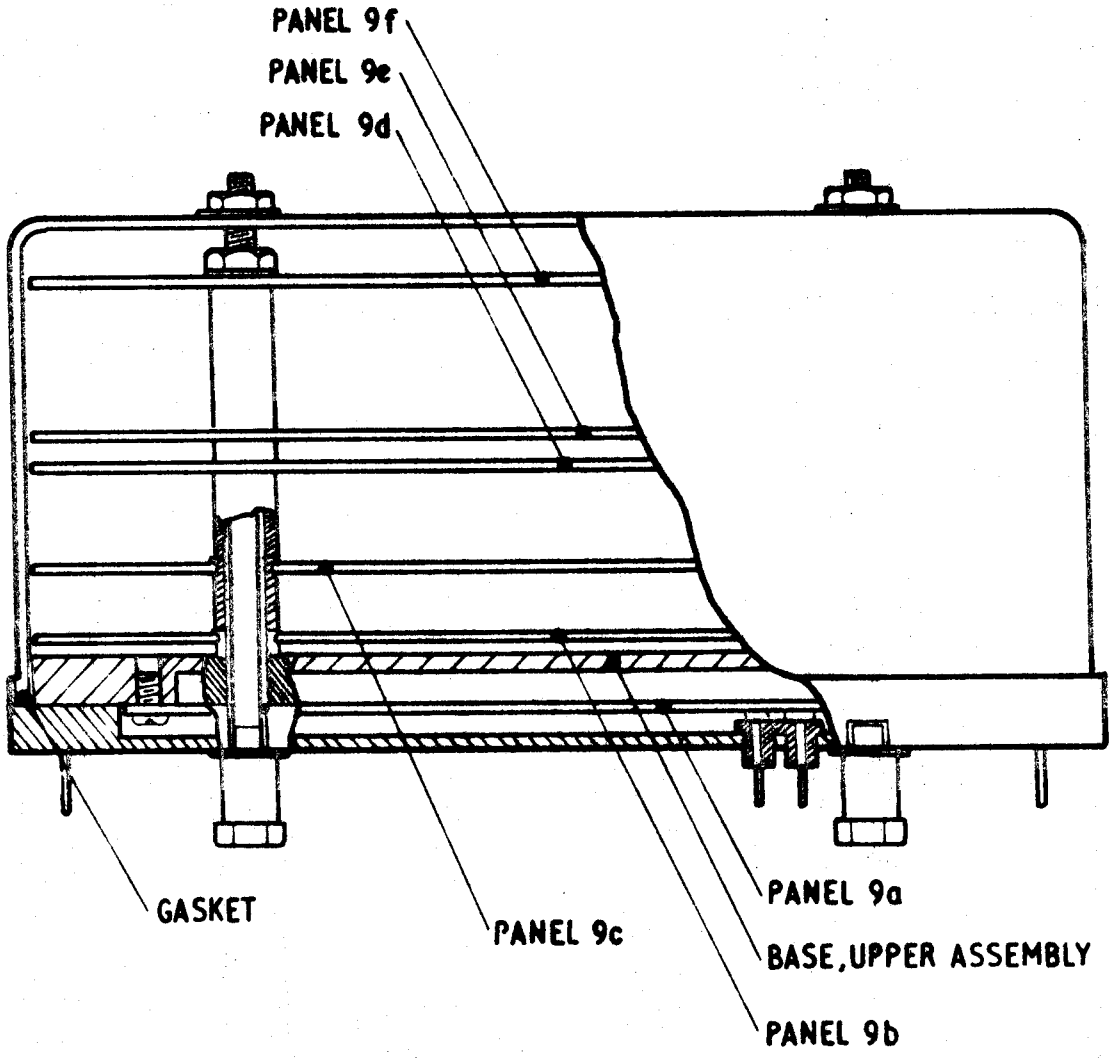


Fig. 13 Synthesizer assembly

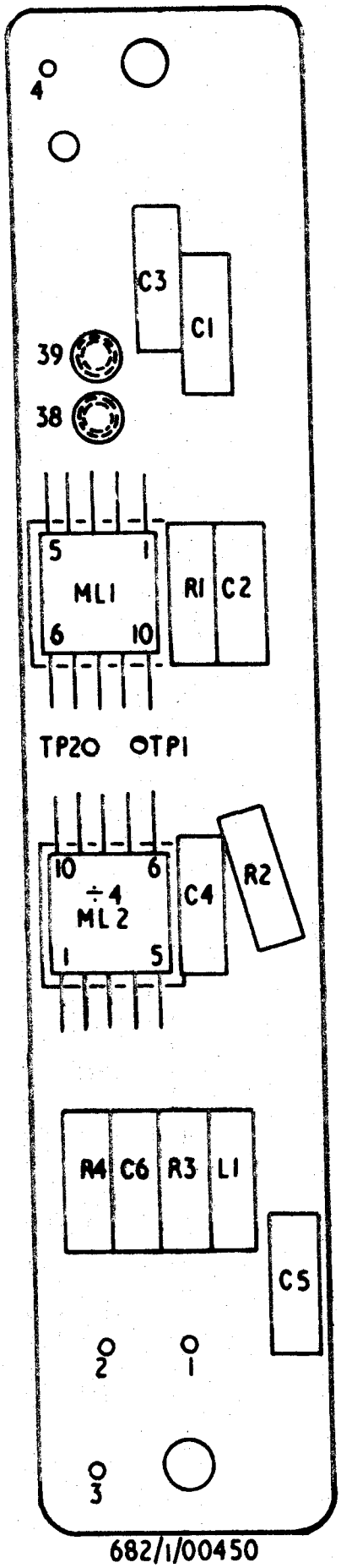


Fig.14
Unit 9a component layout

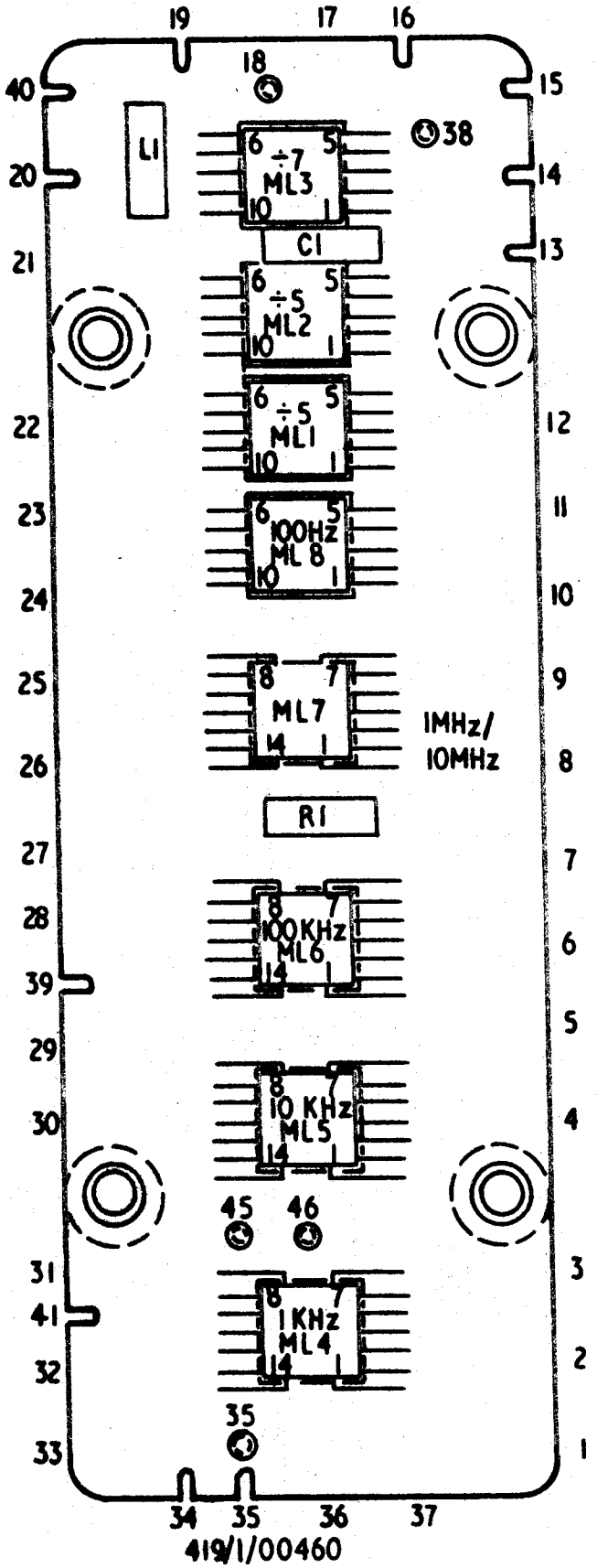


Fig.15
Unit 9b component layout

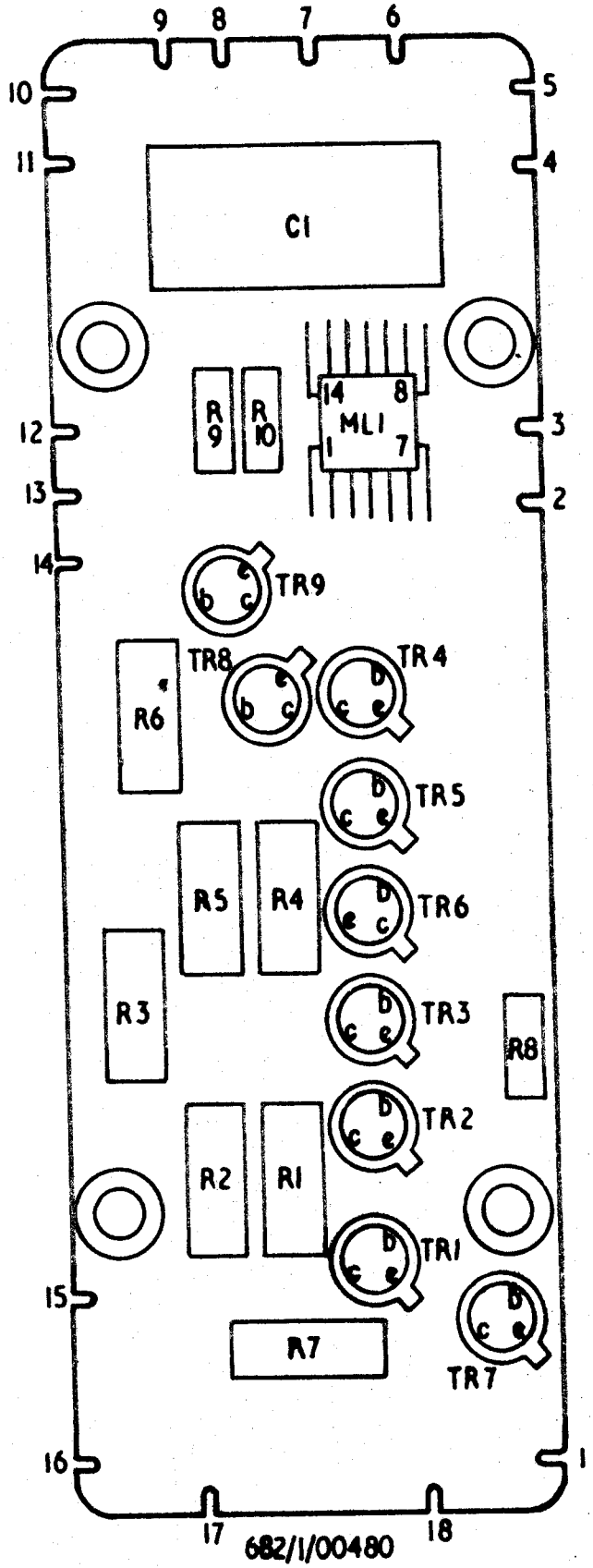


Fig 17 Unit 9d - component layout

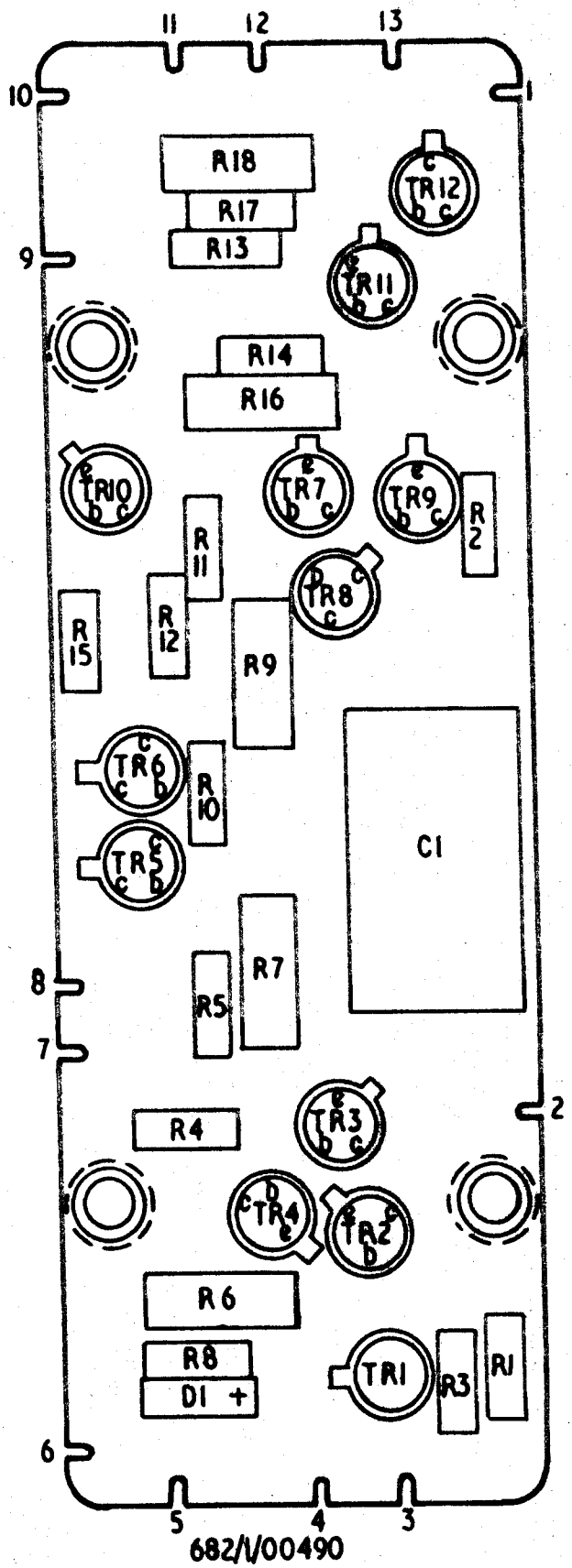


Fig. 18 Unit 9e – component layout

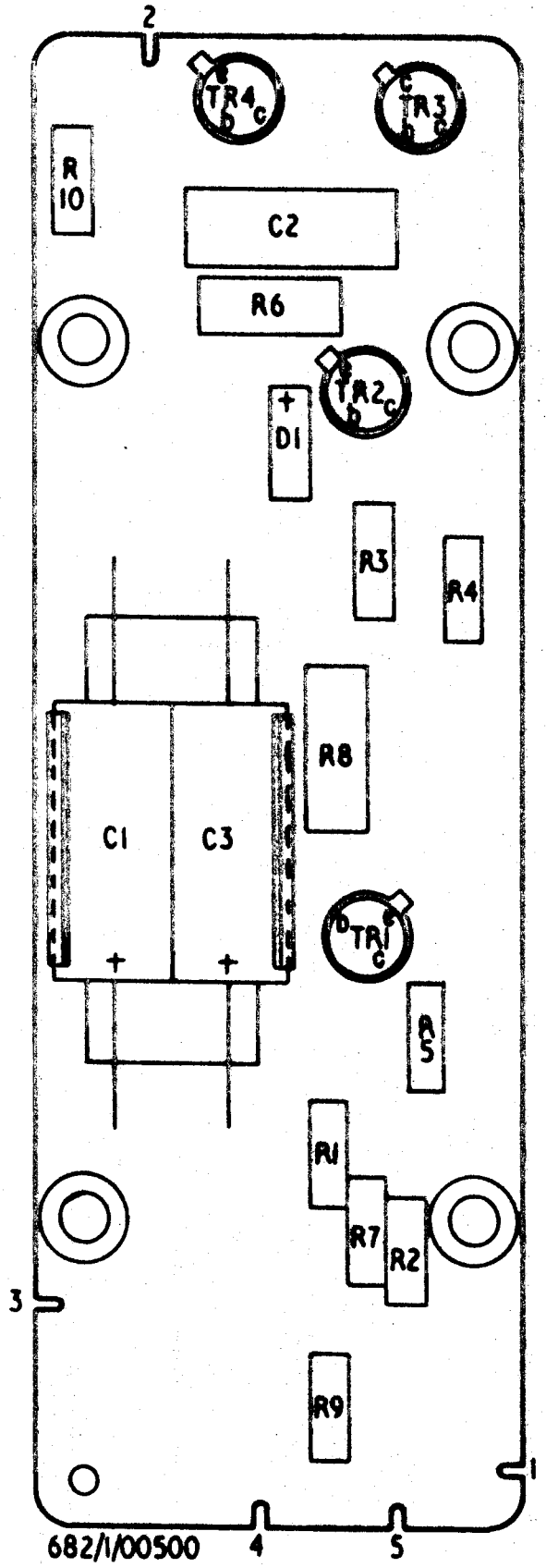


Fig 19 Unit 9f - component layout

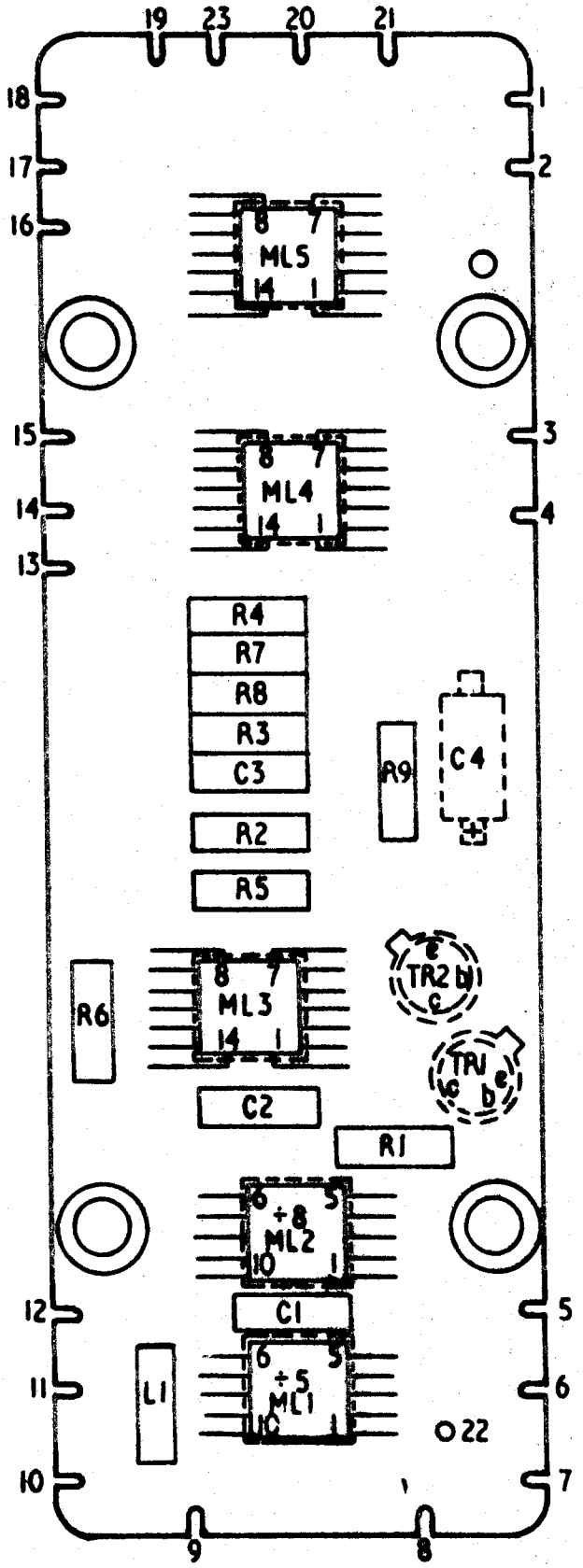


Fig.16 Unit 9c – component layout